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THE OLD WEST REGIONAL COMMISSION
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TEMPORARY/MOBILE FACILITIES FOR IMPACTED COMMUNITIES

PREPARED FOR : THE
OLD WEST
REGIONAL COMMISSION

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JULY 1976

OLD WEST
REGIONAL
COMMISSION

The Old West Region Commission is a Federal-State partnership designed to solve regional economic problems and stimulate orderly economic growth in the states of Montana, Nebraska, North Dakota, South Dakota and Wyoming. Established in 1972 under the Public Works and Economic Development Act of 1965, it is one of seven identical Commissions throughout the country engaged in formulating and carrying out coordinated action plans for regional economic development.

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SUMMARY ABSTRACT

"TOWNS SHOULD BE BUILT SO AS TO PROTECT THEIR INHABITANTS AND AT THE SAME TIME MAKE THEM HAPPY."

ARISTOTLE

Communities experiencing impact growth (a rapid influx of a quasi-permanent or temporary population at such a rate that existing community facilities cannot be modified quickly enough to accommodate the resulting growth in an orderly manner) need temporary/mobile facilities to accommodate temporary (2 to 3 years) construction personnel and their families. Family is a key word. The mobility of our society makes the installation of worker "Construction Camps" a poor solution to the impact problem. It is critical to offer the same amenities and quality of life present in established villages and towns to residents of a temporary community.

Once industry and public sectors have determined a common need for new communities with respect to regional plans, programming can begin. Design criteria should be developed based on community needs representative of the human environment; relevant federal, state and local codes and standards; and optimum portability without sacrificing a high quality of life in the community.

The "state of the art" of manufactured products utilized in a mobile/temporary community varies considerably. Architecturally, mobile homes are the most feasible portable dwellings. Air structures provide long span enclosures with reasonable demountability. Engineering products offer viable, portable treatment equipment (waste water and water), and a few utility distribution and collection systems are designed for non-permanent applications.

Based on our cost estimates, relocation of a community may be economically feasible for three to four subsequent locations. The relocation of the community's architecture is relatively efficient, especially mobile homes. Town planning elements (roadways, landscaping, etc.) are virtually unreclaimable. Engineering costs are not very reclaimable due to the large amount of labor involved. Financing of the community is dependent upon the specific set of circumstances and requirements related to a service program and impact area.

Our recommendations are:

1. Conduct a demonstration project utilizing a broad range of temporary/mobile facilities.

2. Investigate the use of contemporary communication medias to expand community services.
3. Investigate methods to reduce infrastructure installation and reclamation costs.
4. Investigate site reclamation alternatives.
5. Initiate Federal Legislation to nationally standardize highway regulations regarding mobile home transport.
6. Investigate additional methods of procurring financial assistance to aid impacted communities in planning and developing needed facilities.

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INTRODUCTION

With the development of energy resources in the Old West Region, large construction forces will be required, especially for conversion operations. Many of these construction forces will be located in areas where there are existing small towns. These small towns will not have the necessary public facilities to handle a large influx of population. Since the permanent work force which follows the construction phase will be considerably smaller, installation of permanent public facilities large enough to accommodate the construction force is not financially feasible.

At the same time with no additional capacity added to the public facilities sector, the strain on the current systems will be excessive to the point of inadequate health, education and sanitary facilities for not only the construction force but also the current residents of the community. A possible solution to this problem seems to be the provision of temporary, preferably mobile, public facilities.

Temporary facilities which are mobile are the major concern of this project, but facilities which are temporary, but not mobile, will also be considered. The types of facilities to be considered will include the following; educational, cultural, medical, waste water, water, recreational, housing and semi-public.

The objectives of this project are as follows:

1. Identify the state of the art of temporary/mobile public facilities.
2. Assess the performance and overall feasibility of such facilities for communities and construction projects in the Old West Region.
3. Assess the feasibility of a pool of mobile facilities moving from one construction site to another.

Tasks to be performed within the contract include:

1. Identify past impacted communities and how temporary/mobile facilities were implemented. Identify potential impact growth communities.
2. Gather and assess current federal, state, and local standards related to construction, operation, and movement of selected public facilities.

3. Identify and evaluate the current "state of the art" of temporary/mobile units regarding manufacture, movement and organization experience (school systems, Red Cross, Army, etc.).
4. Assess the regional adaptability of presently manufactured and "in-design state" units considering environmental characteristics and restrictive regulations.
5. Develop design criteria for architecture, engineering, and planning of temporary/mobile facilities.
6. Assess the preliminary economics of using temporary/mobile units based upon cost estimates and financial alternatives.
7. Identify areas of needed additional research and theoretical design of temporary/mobile facilities.
8. Formulate specific recommendations related to the placement and use of temporary/mobile units.
9. Establish general guidelines for a demonstration project if feasible.

REGIONAL FRAMEWORK

INTRODUCTION

MAJOR COAL FIELDS

TRANSPORTATION

POPULATION

TRADE CENTERS

INTRODUCTION

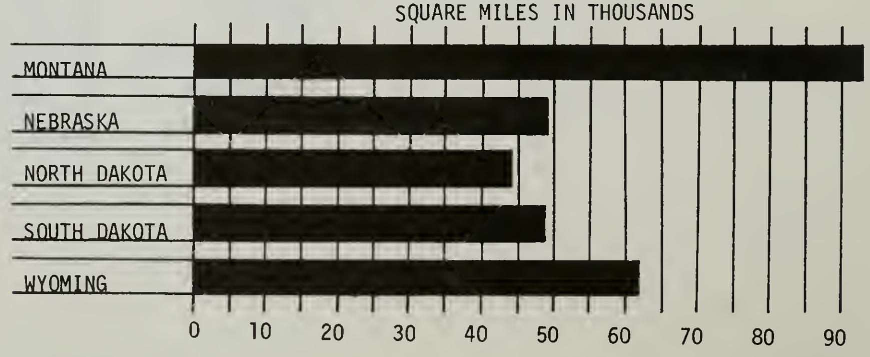
The states of Montana, Nebraska, North Dakota, South Dakota and Wyoming comprise the Old West Region. These five states make up approximately 11% of the land area of the United States. Most of the Old West Region is sparsely populated, generally due to land use and physical extremes (meteorlogical and geographical). The development of the Old West Region will proceed as the need for useable land and energy increases.

The lack of transportation corridors to all developing areas will be a handicap. This could be especially true throughout the Great Plains and the Wyoming Basin/Range with the development of the richest bituminous coal deposits in the Old West Region. Only by coordinated planning of governments and industries will the major trade centers of the region be efficiently interconnected.

For purposes of this study the five-state Old West Region was divided into five highly distinguishable physiographic provinces as illustrated in Figure II-1. Each of the identified provinces exhibits significant differences in the distributions of population, available services, coal deposits, and environmental factors. These factors will influence the design and siting requirements for mobile and temporary housing and

LAND AREA

TABLE II-1



PRINCIPAL PHYSIOGRAPHIC PROVINCES

SOURCE: HNTB (MODIFIED FENNEMAN, 1928)

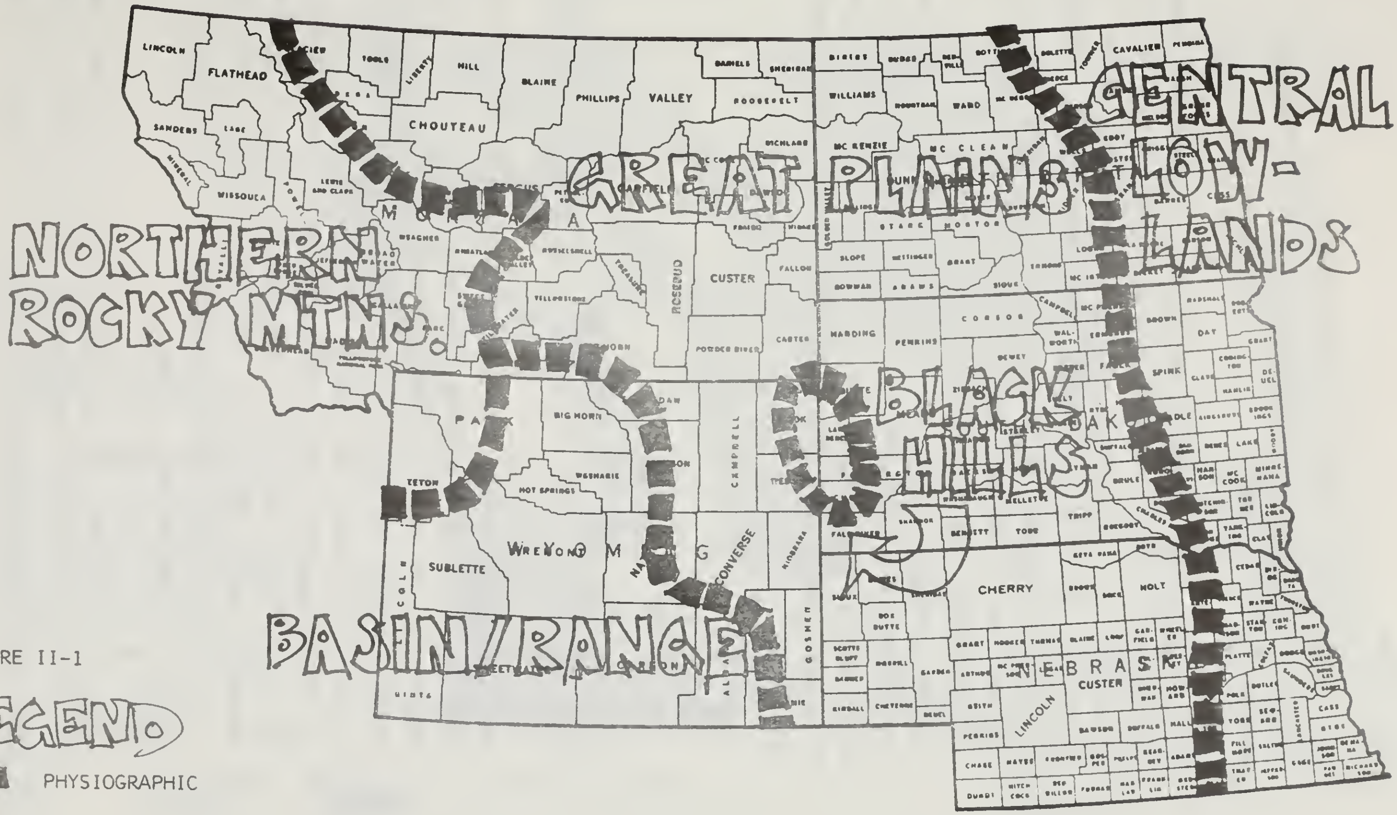


FIGURE II-1

LEGEND

▬ PHYSIOGRAPHIC

service facilities. These five major provinces are: Central Lowlands, Black Hills, Great Plains, Wyoming Basin/Range and the Northern Rocky Mountains.

These five provinces encompass approximately three hundred thousand square miles of some of the most diverse physiography found in the United States. In the eastern portion of the Old West Region is found the heavily cultivated prairies of the Central Lowlands. Gradually, almost imperceptively, the general elevation increases from east to west and culminates in the Rocky Mountains found in northern Wyoming and western Montana. In the central portion of the Old West Region are found the semi-arid high plains, the subhumid Black Hills and the high arid intermountain basins of Wyoming. The widely varied environmental aspects exhibited within these five identified regions should be considered in the design, transport, siting and installation of temporary/mobile facilities.

MAJOR COAL FIELDS

The regional distribution of mineral deposits in the Old West Region demarcate the areas of existing and potential impact growth. These deposits include the widely scattered hard-rock minerals in western Montana, Wyoming and in the Black Hills, the low-grade iron ore deposits in the Black Hills and the Atlantic/South Pass area of central Wyoming, the uranium deposits in southeastern Montana and southcentral Wyoming, and the rich potash deposits in northeastern Montana. The mining and consumption and/or processing of the rich bituminous, lignite and brown coals in the Old West Region are generally the activities that will produce the greatest impact growth.

Figure II-2 identifies the major coal fields in the Old West Region. These have been labeled: Dakota/Montana Rolling Plains, High Plains West, Basin/Mountain Front, Big Horn Basin, and Southwest Wyoming.

MAJOR COAL FIELDS

SOURCE: NATIONAL ATLAS, 1970, COAL DISTRIBUTION & HNTB (COAL FIELDS DEMARCATION)

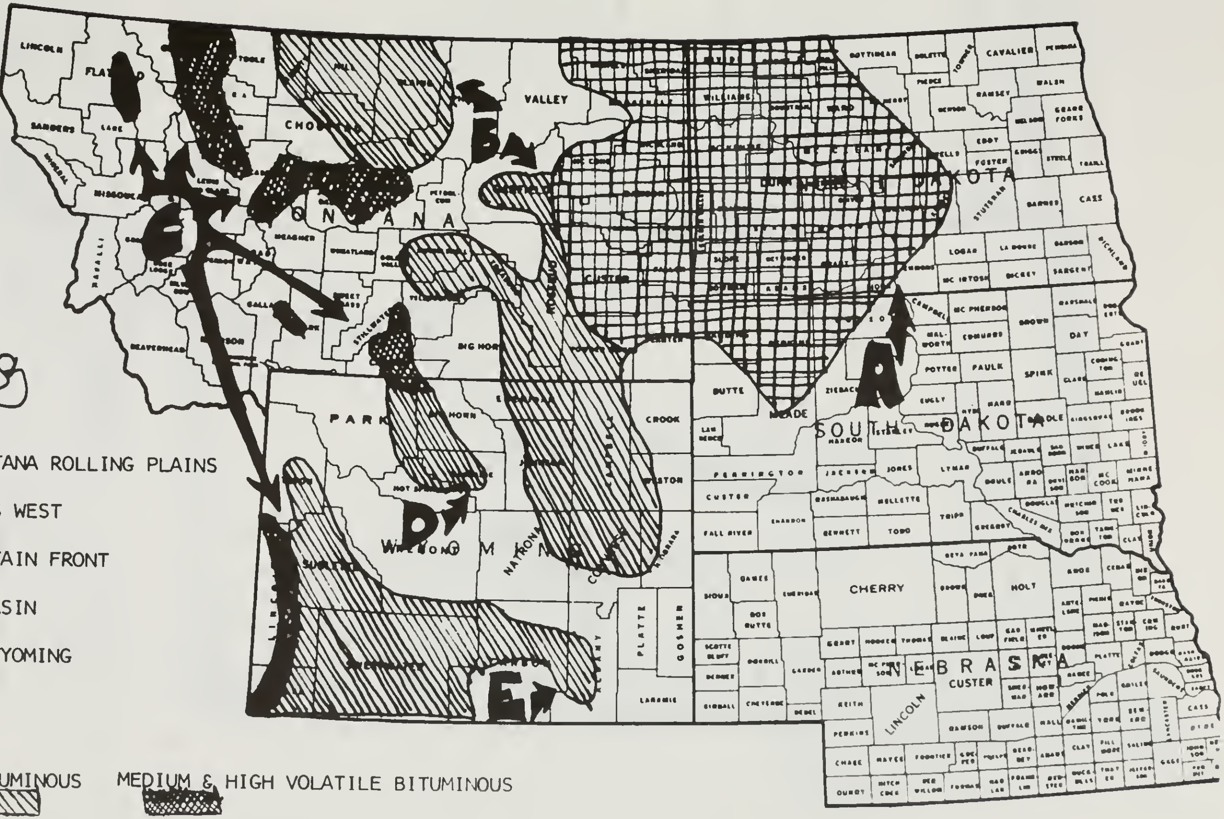


FIGURE II-2

FIELDS

A. DAKOTA/MONTANA ROLLING PLAINS
B. HIGH PLAINS WEST
C. BASIN MOUNTAIN FRONT
D. BIG HORN BASIN
E. SOUTHWEST WYOMING

LEGEND

▦ LIGNITE & BROWN
▨ SUBITUMINOUS
▩ MEDIUM & HIGH VOLATILE BITUMINOUS

The largest mines operating within these five major fields is listed in Table A-5 (appendix). The Decker Mine, located in southern Big Horn County, Montana, is presently the largest producing coal mine in the Old West Region and the second largest producing bituminous mine in the United States.

The other large mining operations in the Old West Region are located in Rosebud County, Montana; Mercer County, North Dakota; and Sheridan, Carbon, Campbell, Converse, Lincoln and Sweetwater counties in Wyoming. Coal is mined either for consumption at or near the mine sites as in the case of the Knife River Mine (North Dakota) or is transported out-of-region like the Decker Mine in Montana.

Several proposals are being considered to either reopen abandoned mines or commence new mining activities in the Lake Sakakawea area of North Dakota; Blain, McCone, Musselshell, Carbon, Big Horn, Rosebud, Powder River and Flathead counties in Montana; and Sheridan, Johnson, Campbell, Converse, Carbon, Sweetwater and Lincoln counties in Wyoming in response to the several related proposals for fossil fuel power and coal gasification plants.

TRANSPORTATION

The major rail and highway corridors in the Old West Region are oriented principally east/west (see Figure II-3). Rail development is sparse but well distributed through the Old West Region. The primary rail corridors parallel each other and vary from approximately fifty to one hundred miles apart. Essentially completed by the beginning of the nineteenth century, the railway system was important in determining the present-day population distribution throughout the region, especially in the Great Plains province. The principal railroad companies operating in the Old West Region are Burlington Northern (most dominant), Milwaukee (through northern South Dakota and southern Montana), North Western

MAJOR TRANSPORTATION CORRIDORS 1976

SOURCE: U.S.G.S.

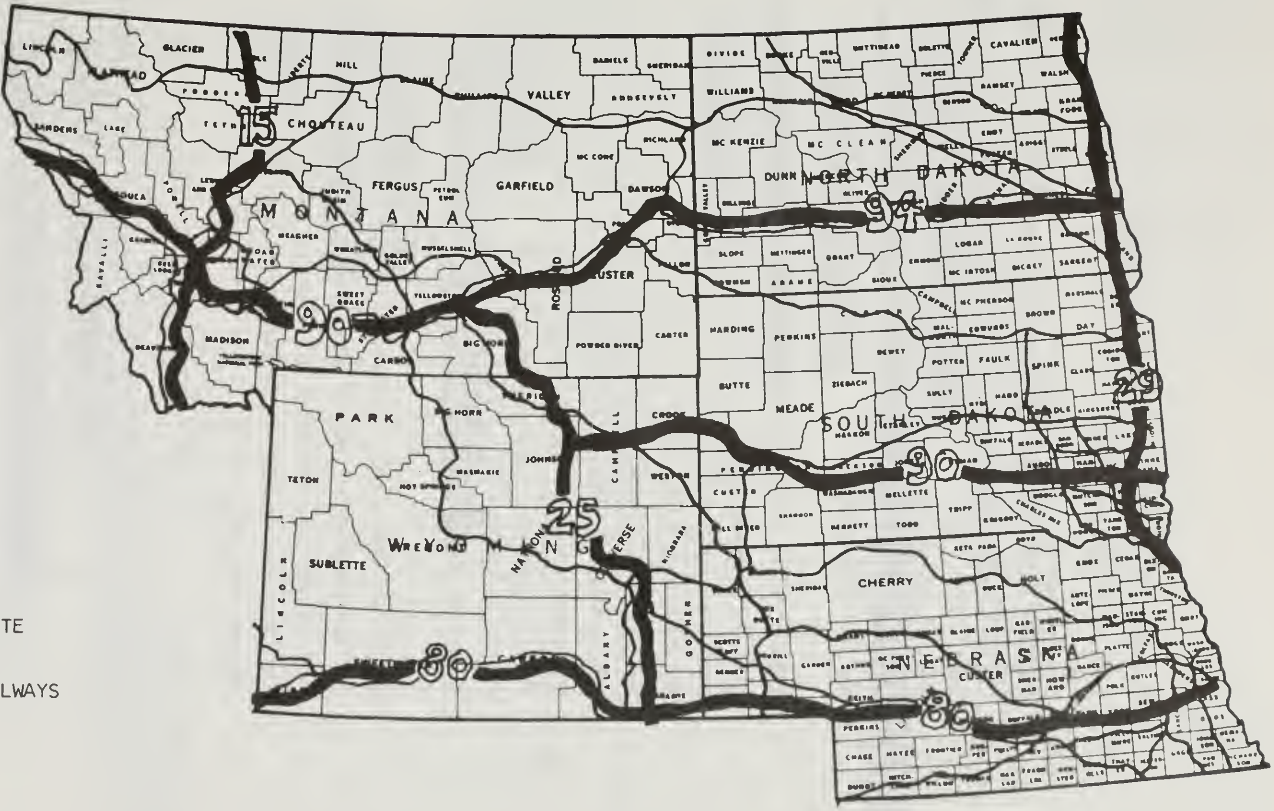


FIGURE II-3

LEGEND

90 INTERSTATE HIGHWAYS

PRIMARY RAILWAYS

(through central South Dakota) and Union Pacific, (through southern Wyoming and Nebraska).

Although major interstate freeways presently provide adequate trans-regional east/west access in the Old West Region, access to the major coal fields remains comparatively primitive. Inadequate local roads with steep grades, sharp turns, and old, narrow restricted weight bridges have recently been identified as an important impact growth issue in the Old West Region.

Traditionally, transportation corridors in the Old West Region (air, rail, or highway) have had an east/west orientation. North/south transportation needs substantial improvement. The proposed Burlington Northern and Chicago and Northwestern rail line between Gillette and Douglas in northeastern Wyoming is a major rectifying step. Other transportation modes will hopefully be developed in southeastern Montana and other areas of the Old West Region to provide north/south access of energy resources. New highways and air travel routing should also be developed to facilitate the movement of people to and from work locations and trade centers.

While rail and highway represent the most practical forms of transportation for the movement of mobile and temporary facilities throughout the Old West Region, air transport is also available with major air terminals strategically located in Casper, Sheridan, Billings, Great Falls, Bismark, and Rapid City, all of which are located on the Interstate System.

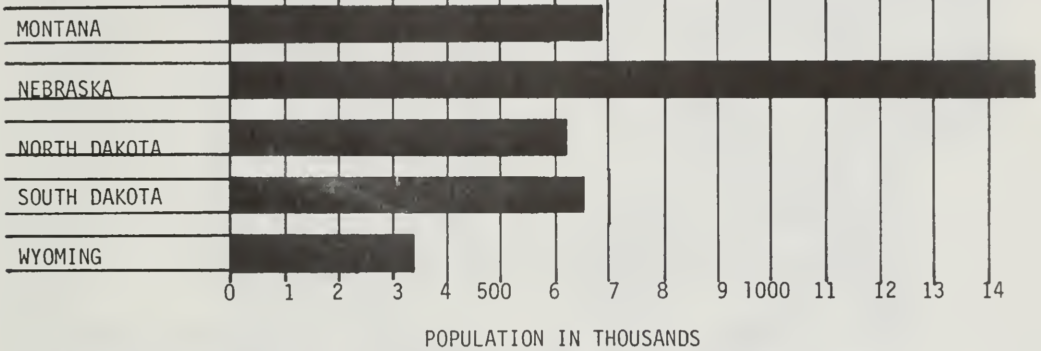
POPULATION

The total population in the Old West Region in 1970 was approximately 3.8 million (two percent of the total U.S. population). At least one-half of the region total population base or one and one-half million persons were concentrated in the fertile Central Lowlands in eastern North and South Dakota, and Nebraska. Most of the remaining persons were largely concentrated in the several service nodes in the western portion of the Old West Region.

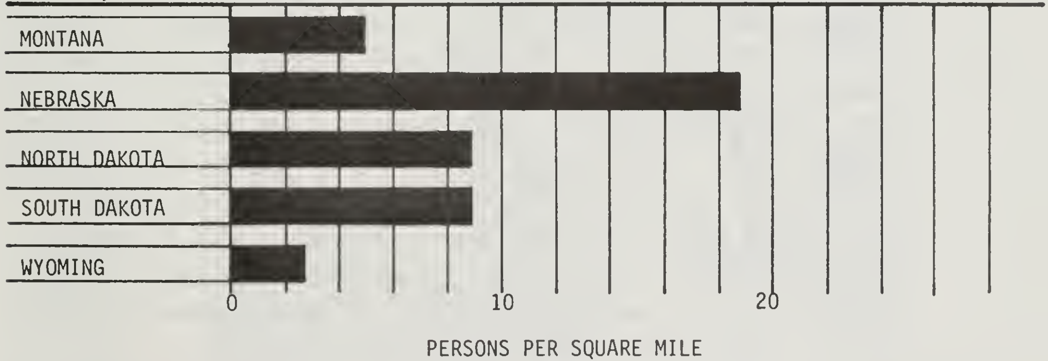
POPULATION STATISTICS 1970

TABLE II-2

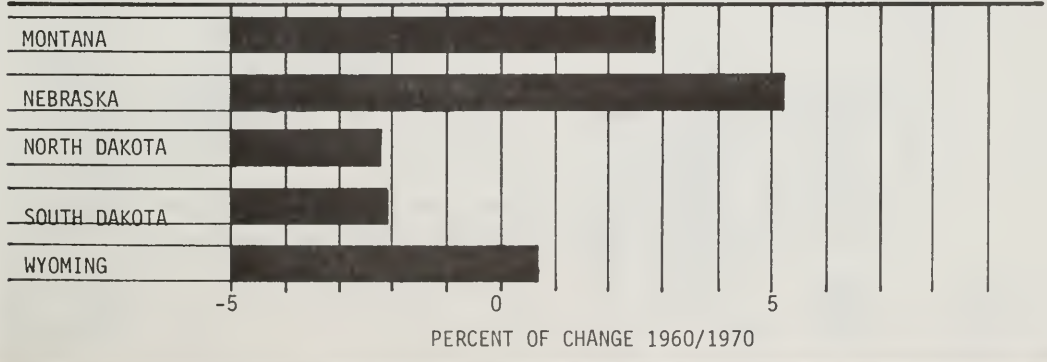
POPULATION: DISTRIBUTION



POPULATION: DENSITY



POPULATION: PERCENT CHANGE



The overall population distribution in the Old West Region is characterized by extensive areas of very low density (under two persons per square mile) as depicted in Figure II-4. Most of the state of Wyoming and large sections of Montana and South Dakota represent some of the lowest density inhabitated areas in the United States. In contrast, the highly fertile and cultivated Central Lowlands is moderately dense, ranging from 10 to 25 people per square mile. In this latter portion of the Old West Region the largest urban concentrations occur in Grand Forks, Fargo, Sioux Falls, Omaha (the largest metropolitan area in the Old West Region) and Lincoln. In contrast, the greatest population concentrations in the sparsely inhabited western portion of the Old West Region are found along the major east/west transportation corridors and in the several irrigated intermountain basins and valleys. Casper, Billings, Great Falls, Cheyenne, and Rapid City are the major population centers in this area.

With isolated exceptions such as the "Oil Boom" in Gillette, Wyoming in the late sixties, the population growth throughout the semi-arid portion of the Old West Region was either declining or slightly increasing. Increases mainly occurred in the larger trade centers such as Billings, Montana. Since 1970, several dramatic isolated population increases have occurred throughout the coal regions and the larger cities of the Old West Region. This trend is reflected in the total estimated net change between June 1, 1970 and July 1, 1973. In this three-year span, population growth in all five states was positive with Wyoming achieving the greatest growth rate of 6.1 percent. Montana also had a substantial estimated increase of 5.1 percent. The remaining three states increased between 2.3 and 3.2 percent. The region as a whole increased 3.4 percent which is slightly more than the national growth rate.

TRADE CENTERS

The regional organization of major trade centers is characterized by a distinct hierarchy of centers and their respective trade areas.

POPULATION DISTRIBUTION 1970

SOURCE: UPPER MIDWEST COUNCIL, (DISTRIBUTION FOR MONTANA, N. DAKOTA, & S. DAKOTA), HNTB (DISTRIBUTION FOR WYOMING & NEBRASKA)

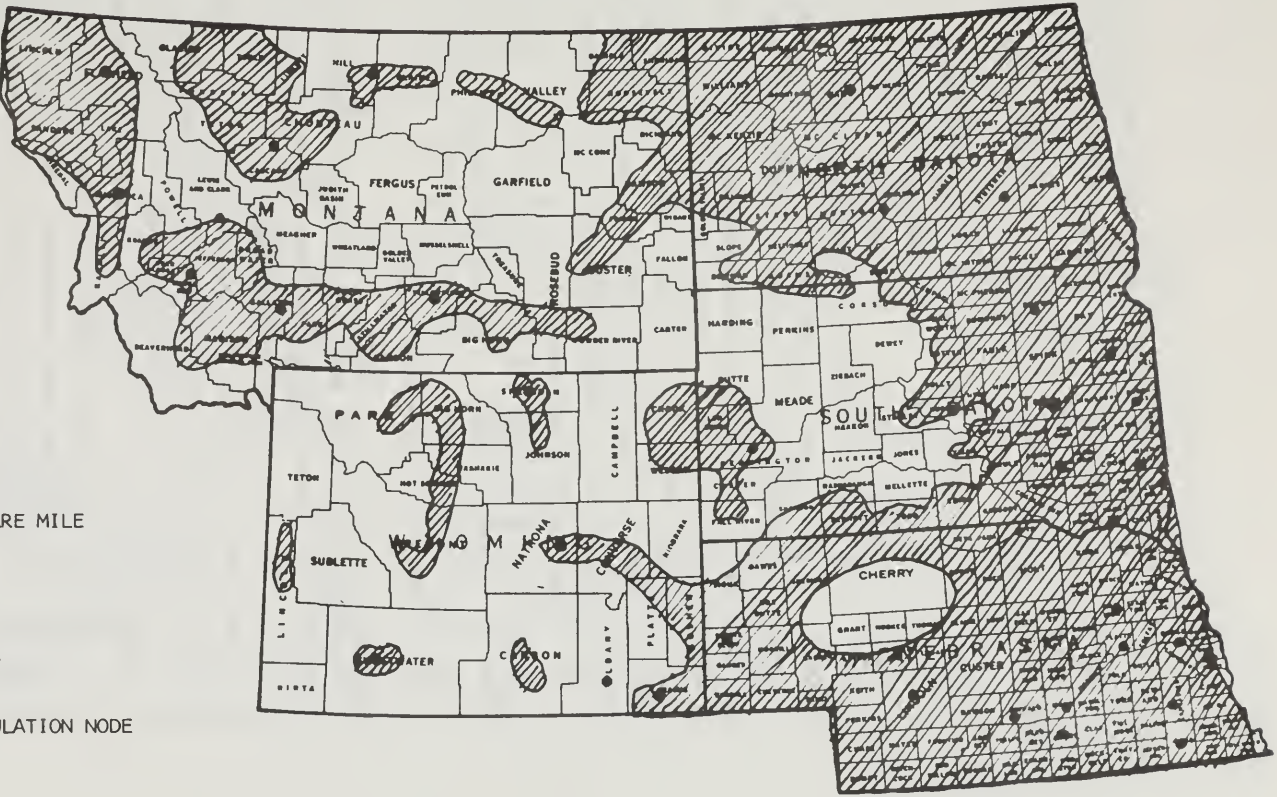


FIGURE II-4

LEGEND

PERSONS PER SQUARE MILE

☐ UNDER 2

▨ 2 AND OVER

● MAJOR POPULATION NODE

Figure II-5 shows the distribution of those centers that range from primary or "metropolitan" to full convenience. The distribution, size and composition of these centers will to a large extent influence the nature and distribution of impact growth in the Old West Region.

The trade area boundaries represent the approximate areas of trade for the primary order centers. In Nebraska: Omaha, Lincoln; in South Dakota: Sioux Falls and Rapid City; in North Dakota: Fargo/(Moorhead), and Grand Forks/(East Grand Forks); in Montana: Billings, Great Falls, and Missoula; and in Wyoming: Cheyenne and Casper. The remaining large population nodes exhibiting less trade influence are Kearney, North Platte, Scottsbluff, Grand Island, Fremont, and Beatrice in Nebraska; Aberdeen, Watertown, Huron, Mitchell, Yankton and Brookings in South Dakota; Minor, Bismark/Mandan, Williston, Dickinson, Devils Lake and Jamestown in North Dakota; Sheridan, Rock Springs, Gillette, Rawlins and Laramie in Wyoming; and Kalispell, Butte, Bozeman, Helena and Havre in Montana. These additional 28 cities together with the 11 functioning metropolitan centers provide the majority of all regional trade, personal, business, and professional services in the Old West Region. It should be emphasized that the function rather than the size of the city was considered in determining its relative trade position.

The population among the metropolitan centers varies from 25,000 to 350,000. The second order or "regional" centers vary from 10,000 to 25,000. The three largest service centers in the central part of the Old West Region (1970 Census) are Rapid City(43,836), Casper (39,361), and Billings (61,581). The highly strategic locations of these three cities in relation to the major bituminous coal fields assure them of increasing prominence in the overall economy of the Old West Region. If straight lines are drawn between these three important centers, the triangle that would be formed encompasses some of the richest coal deposits in the Old West Region. Overall future impact growth could be more severe within that triangular area than in any comparatively sized area in the Old West Region. The principal trade centers that would be involved are Sheridan, Buffalo, Gillette, Newcastle and Douglas.

MAJOR SERVICE CENTERS AND PRIMARY TRADE AREAS 1973

SOURCE: UPPER MIDWEST COUNCIL (CENTER DISTRIBUTION IN MONTANA, N. DAKOTA & S. DAKOTA) HNTB (CENTER DISTRIBUTION IN WYOMING & NEBRASKA) 1974 COMMERCIAL ATLAS & MARKETING GUIDE (TRADE AREA)

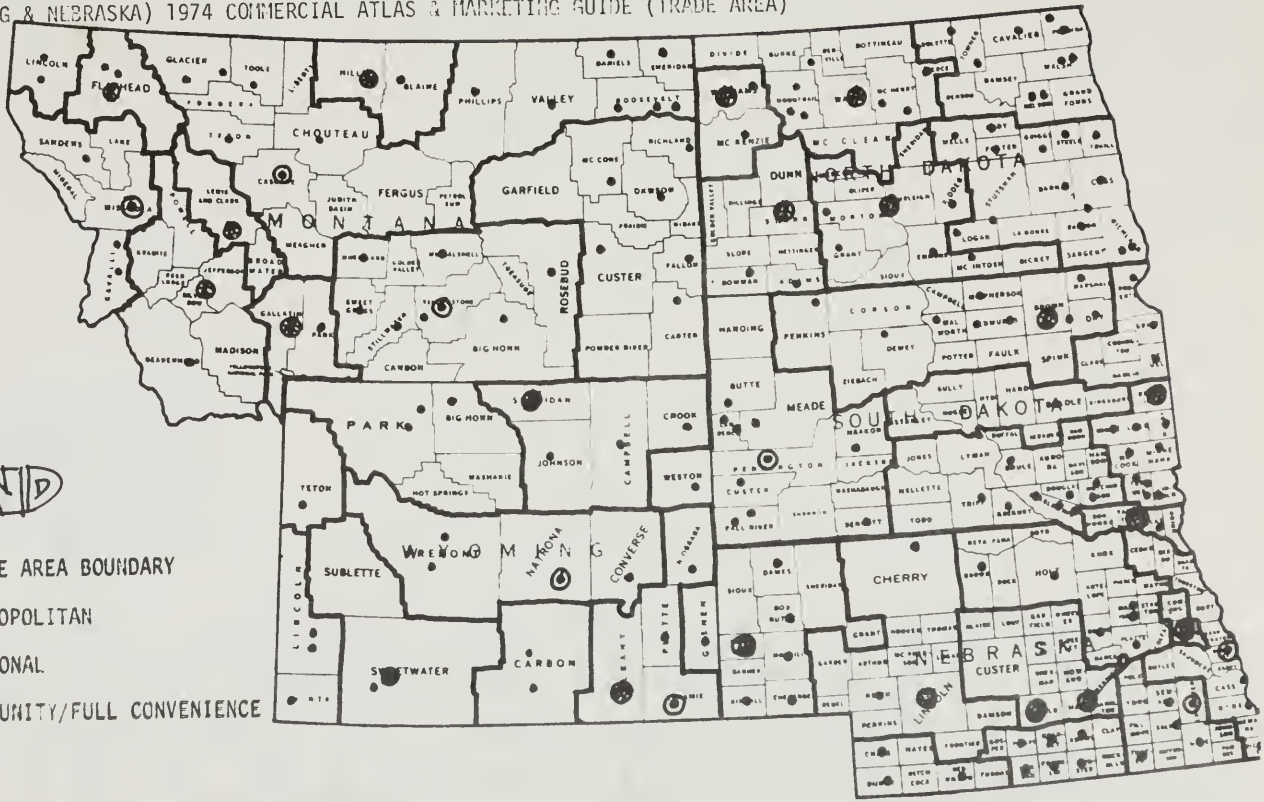


FIGURE 11-5

LEGEND

TRADE AREA BOUNDARY

◉ METROPOLITAN

⊗ REGIONAL

● COMMUNITY/FULL CONVENIENCE

BACKGROUND

IMPACT GROWTH
ENERGY SITES
IMPACT ZONES
PRIMARY ISSUES
PLANNING POWER
PLANNING RESPONSE
LAST WORD
FOOTNOTES

IMPACT GROWTH

Impact growth in the Old West Region can be evidenced in terms of (1) the rapid expansion of existing communities, (2) the development of new complete communities, and (3) extensive, scattered low-density development surrounding the established community but located within the county's jurisdiction. In cases (1) and (3), impact growth usually requires the renovation and expansion of existing community public facilities or the design and construction of completely new facilities.

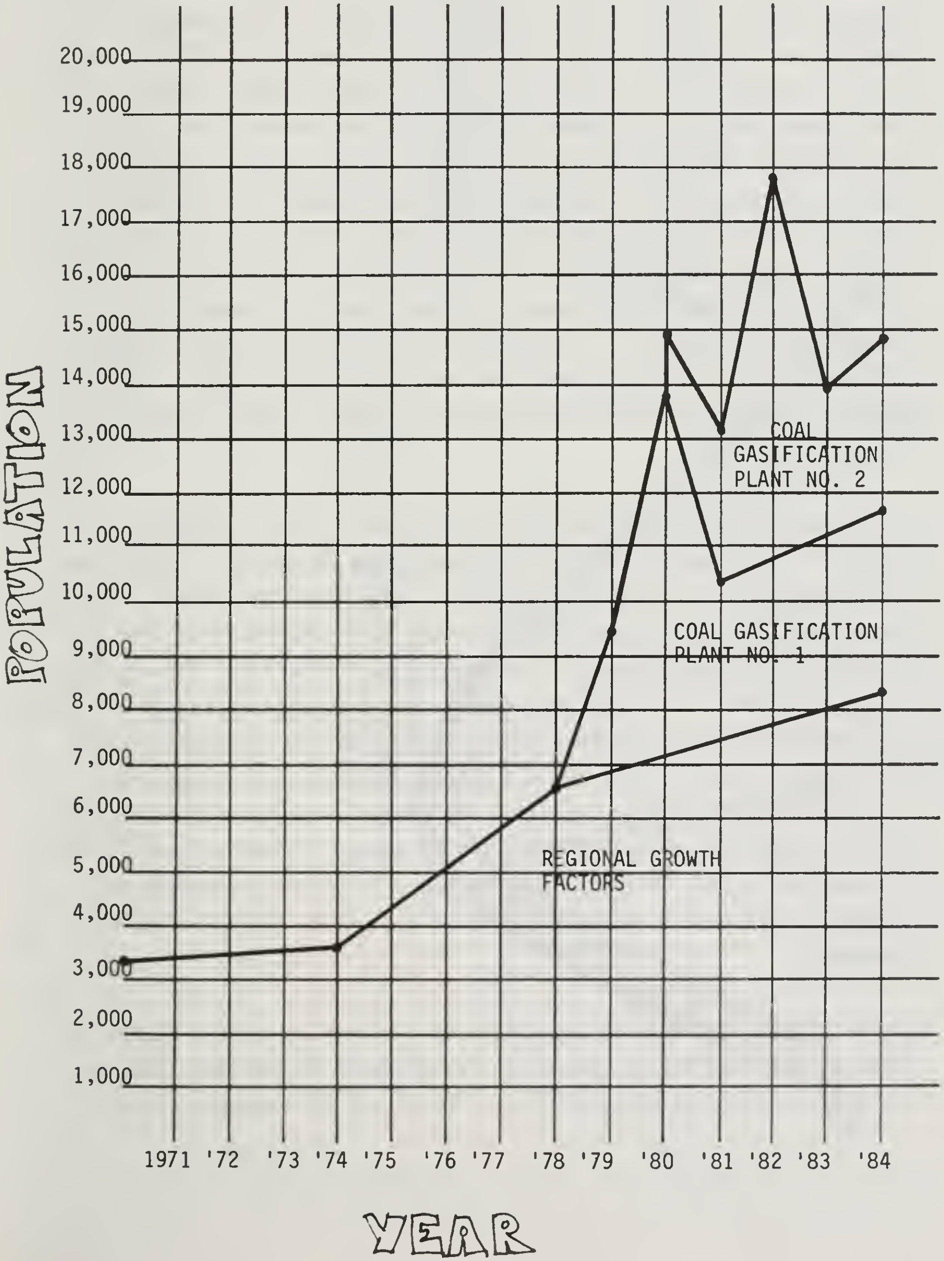
Impact growth, as defined in this report, represents a rapid influx of a temporary or quasi-permanent population at such a rate and volume that the existing community facilities cannot accommodate the resulting growth in an orderly manner. Usually the initial first stage in impact growth is reflected in the shortage of housing and the lack of planned areas for mobile homes. Housing, normally being the first type of facility impacted is usually the first to be rectified and in many cases without a thorough understanding of the consequences of rapid expansion of housing upon the general community facilities and services, such as water, sewer, schools, medical, recreation, law enforcement, fire protection and transportation network.

Impact growth in the Old West Region has resulted from a complex interplay between the need for large construction forces over a relatively short span of time and the resident location options. For example, one of the main reasons given for the dramatic impact growth in the two small communities of Lyman and Mountain View (located in the Jim Bridger Valley in southwestern Wyoming) was that the majority of the large construction force required for the expansion of trona processing, selected those two communities over the equidistant larger communities of Rock Springs and Green River. Principally because of the existing saturated growth conditions of the latter two cities. Impact growth however does not necessarily require a construction force situation, but can result from the rapid influx of service employment people seeking permanent residency which might be the case in Casper, Wyoming.

FIGURE III-1

PROJECTED "SHORT INTERVAL" IMPACT

GROWTH FOR BUFFALO, WYOMING SOURCE: BUFFALO-JOHNSON COUNTY PLANNING OFFICE



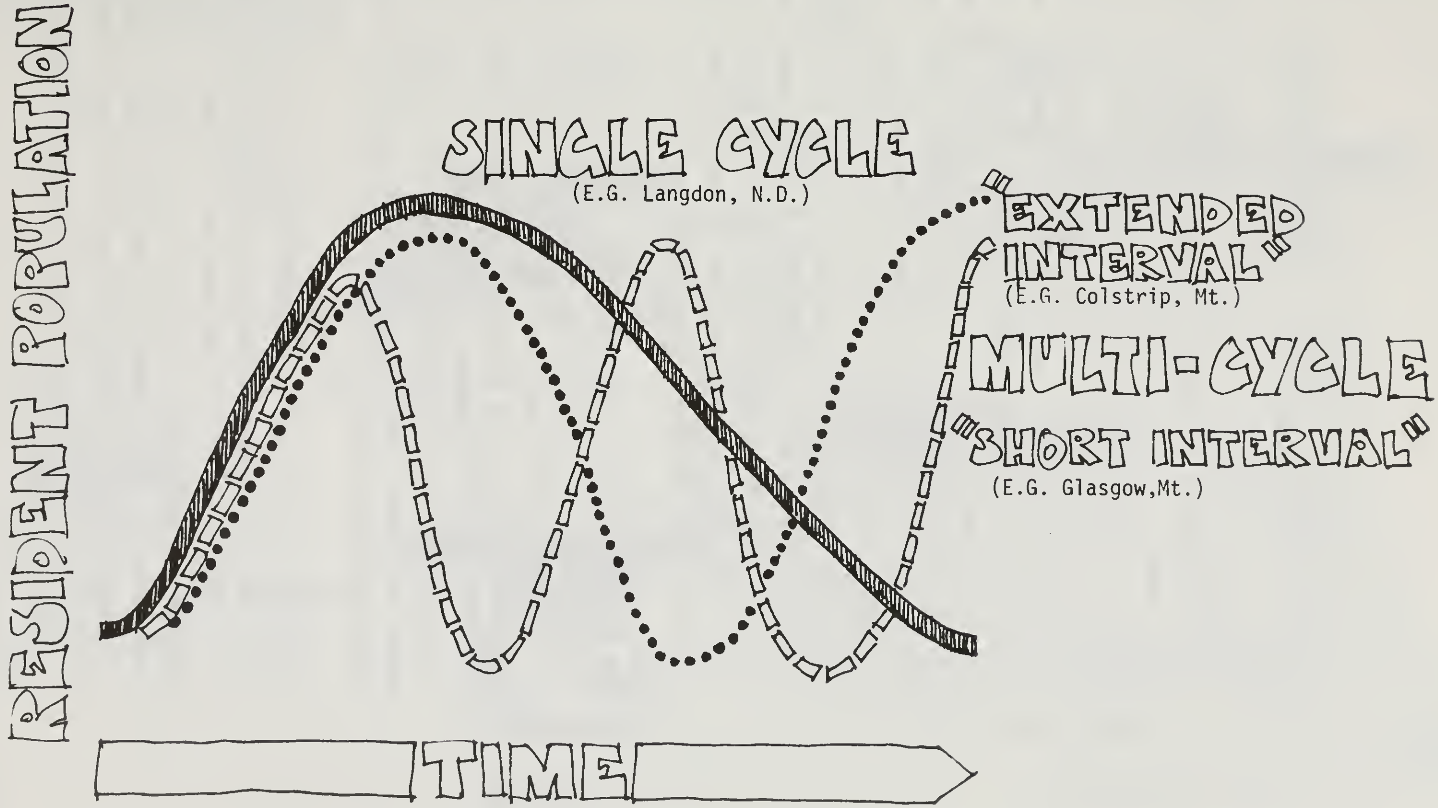
The principal characteristics of impact growth are a sharp initial increase and a decline in a resident population base. This growth cycle is characteristically a one-time occurrence such as examplified by Langdon, North Dakota; Conrad, Montana; and Newell, South Dakota (all impacted as the result of the installation of the missile defense network in the northern Great Plain in the 60's). However, many communities in the Old West Region that have experienced impact growth in the past or are currently experiencing impact growth will most likely experience such future cycles. It is assumed that the frequency of these multi-cycles will vary considerably throughout the Old West Region. For purposes of this report, they have been broadly categorized into "short interval" (one to five years) and "extended interval" (over five years). An example of the former is Colstrip, Montana and of the latter, Glasgow, Montana. In addition to the construction impact growth cycles, more permanent types of impact growth induced by other factors also can be anticipated.

The "construction-force" impact growth is generally more difficult to respond to than what might be termed "permanent-residency" impact growth. The former situation required not only a sudden need for large capital investments for housing and general public services, but also this investment is in response to a temporary growth situation. The latter situation allows for normal long-term economic consideration and utilization of large initial investments. Consequently, private financing capital for permanent type facilities in the more common construction force situation is difficult or impossible to secure and municipal and county bond indebtedness is equally difficult to repay. Therefore, the planning for and utilization of mobile and temporary facilities, wherever and whenever functionally feasible, in those situations should be seriously considered.

The principal challenge of impact growth strategy is to provide all the services required for a community at peak impact at the least public cost and disruption of existing social, cultural and environmental fabric.

HYPOTHETICAL CONSTRUCTION IMPACT GROWTH CYCLES

FIGURE III-2



ENERGY SITES

Development of the major coal fields in the Old West Region has so proceeded where it is possible to discern the evolving future impact growth pattern. As shown in Figure III-3, four principal areas are dominant in terms of energy development and related activities. These have been labeled: Lake Sakakawea Energy Complex in North Dakota, Big Horn/Tongue River Basins Energy Complex in southeastern Montana, the Powder River Basin Energy Complex in northeastern Wyoming, and the Green River Basin Energy Complex in southwestern Wyoming. Of these four areas, the Lake Sakakawea Complex is projected to develop most rapidly due to the proximity of the abundant waters of Lake Sakakawea and the excellent shallow lignite coal deposits. This particular area is emerging as one of the most important electric power generation and coal processing complexes in the Old West Region. The dramatic impact that will result from this proposed massive construction program is illustrated in Figure III-4. It has been projected that an additional 7,000 construction workers will be required between January 1976 and January 1980.

The Green River Basin area in southwest Wyoming has been severely impacted since 1970 when Pacific Power & Light commenced construction of its 2000 MW Jim Bridger fossil fuel power plant thirty miles to the east of Rock Springs and the expansion of several soda ash processing facilities located in western Sweetwater County. The impact growth of the Green River Basin area has been subjected to probably the greatest amount of research into the causes and consequences of impact growth in the Old West Region to date.[1]

The areas of the Powder River Basin in Wyoming and the Big Horn/Tongue River Basins in Montana are currently experiencing impact growth comparable to the Green River Basin in 1972 and 1973. Impact is the result of expanded and new large coal mining activities together with the current construction projects of Montana Power (2100 mw power plant located in Colstrip, Montana) and Black Hills Power and Light and Pacific Power and Light (350 mw Wyodak power plant located approximately seven miles east of Gillette, Wyoming).

EXISTING / PROPOSED ENERGY RESOURCE CONSTRUCTION SITES

SOURCE: HNTB INTERVIEWS

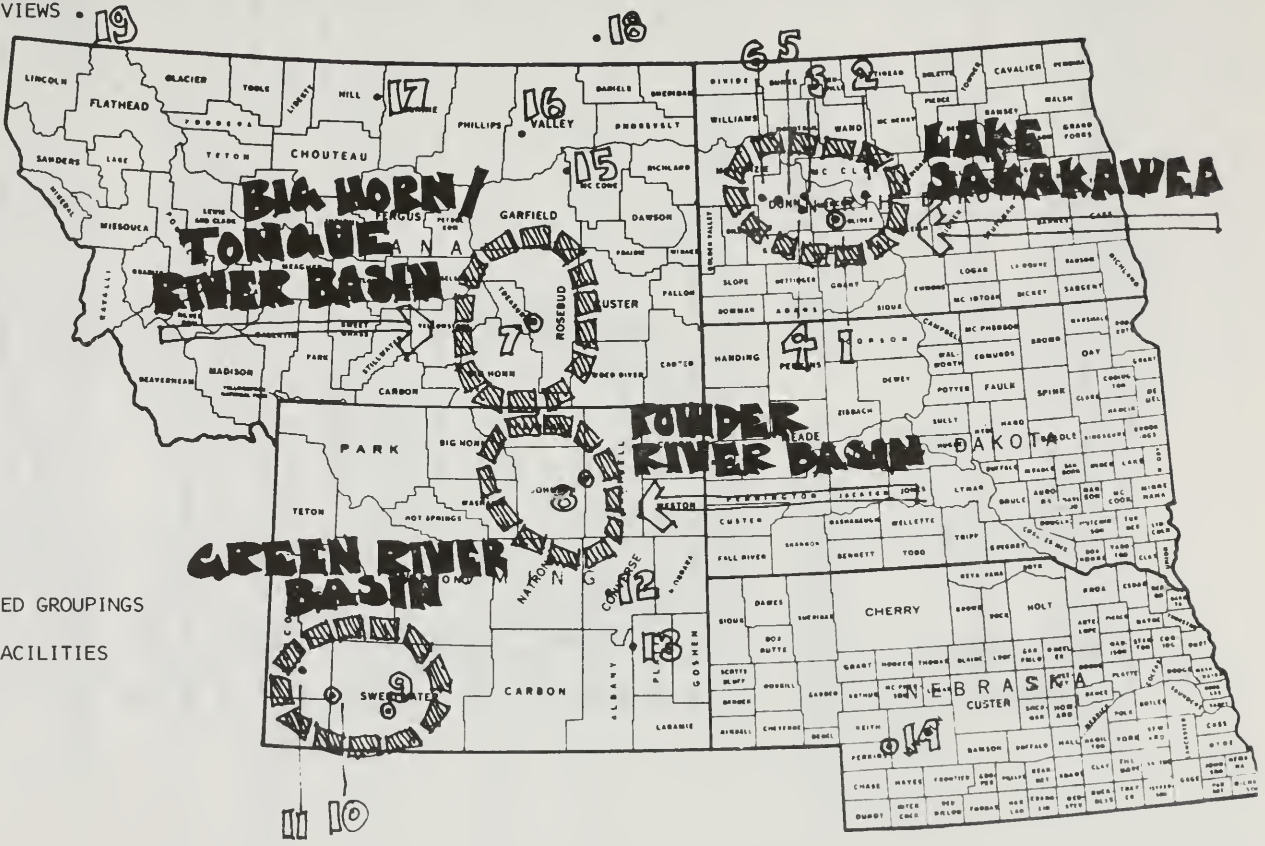


FIGURE III-3

LEGEND

⊙ EXISTING

• PROPOSED

MAJOR PROPOSED GROUPINGS OF COAL USE/ PROCESSING FACILITIES

These activities represent the initial impetus for the anticipated impact to result from the several coal gasification and fossil fuel power plants proposed throughout the three river basins.

Present and proposed similar developments throughout the Old West Region are noted in Figure III-3 and identified in Table III-1.

IMPACT ZONES

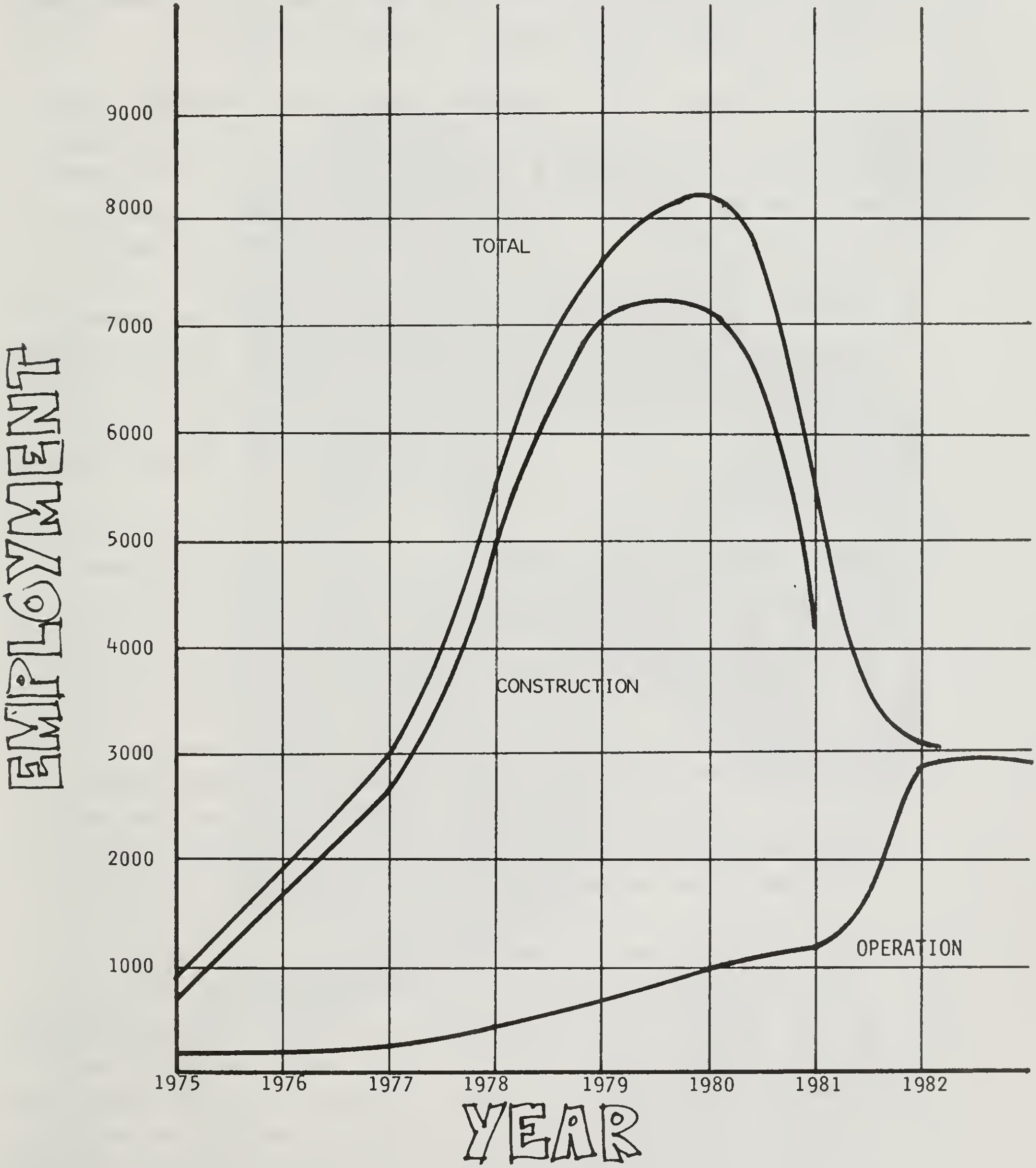
Impact growth has become a hallmark of the development of the western portion of the Old West Region. Historically, it has representated much of the growth in the Old West Region. In the late nineteenth century the "Hard Minerals Rush" resulted in a series of boom towns, the most enduring being the present capital city of Montana, i.e., Helena. Then came extensive logging in the western portion of the region, the Missouri River Flood Control Project in the 1950's and the ICBM system in the Dakotas and Montana in the 1960's. The present surge of impact growth is resulting from the rapid expansion of coal mining activities and the construction of large fossil fuel electric power generating plants. Anticipated impact is from current proposals regarding the construction of several coal gasification, chemical fertilizer, and general mineral processing and conversion facilities, as well as additional coal fired electric power generating plants and numerous strip and underground coal mines throughout the Old West Region. The distribution of communities either experiencing or anticipating impact growth is depicted in Figure III-5.

The significant characteristic of the formerly impacted communities resulting from the Missouri River and the ICBM projects is that their impact growth resulted from federal construction programs. Consequently, substantial federal funds were either given to those impacted communities to assist in the expansion of basic public services as in the case of Langdon, North Dakota, or to construct completely new towns as exemplified in Riverdale, North Dakota. Expansion was generally in terms of permanent facilities rather than temporary or mobile facilities with the exception

PROJECTED EMPLOYMENT

FIGURE III-4

FOR CONSTRUCTION AND OPERATION OF LAKE SAKAKAWEA ENERGY COMPLEX, NORTH DAKOTA
SOURCE: NORTH DAKOTA STATE PLANNING DIVISION



of mobile homes. In contrast the present impact growth communities must respond to massive construction investments by private industry. Consequently, federal assistance of the extent available to those former government impacted communities is no longer available.[2]

In 1975, impact growth was evidenced or anticipated throughout a large portion of the Old West Region as illustrated in Table III-2. However, the extent of existing impact growth has been relatively limited such as in Sheridan Wyoming (See Table III-3) to the extremely dramatic as in Lyman, Wyoming. The Lyman's population base increased nearly 500 percent between 1970 and 1975, ranging from 425 to 2002 in that five year span. The current impact in Sheridan has resulted from several industrial firms setting up field offices in that city and the development of the Decker coal mine site between 1972 and 1974. The impact in Lyman was due to the rapid expansion of soda ash processing plants in the trona mines area located in western Sweetwater County. Similar reasons can be cited for the other impacted communities.

Perhaps the most dramatic expression of "impact growth" is the creation of a new town. Although the present community of Colstrip, Montana is not technically a new town, for planning purposes it can be considered such. Colstrip can be considered as the prototype new town in the Old West Region that has resulted entirely from private capital. It was constructed to accommodate principally the labor force required to construct the four-unit Montana Power Company electric power generation plant and to operate Western Electric's integral coal mine. The total population of Colstrip in the summer of 1975 was estimated at 3200. This community has been designed for a permanent population of 2500.

The presence of Colstrip raises the important question of whether other industrial firms will develop new communities rather than utilize the services and facilities of communities that are within commuting distance (generally considered 35 miles one-way in the western portion of the Old West Region) of the project sites. Although a new town in the Powder River Basin in northeastern Wyoming is especially possible, no serious proposal has yet been made to emulate the Colstrip experiment. Nevertheless, a definite geographic zone for potential new town development does exist in the sparsely settled areas of the Great Plains and the Basin Range province.

IMPACT GROWTH NODES & ZONES

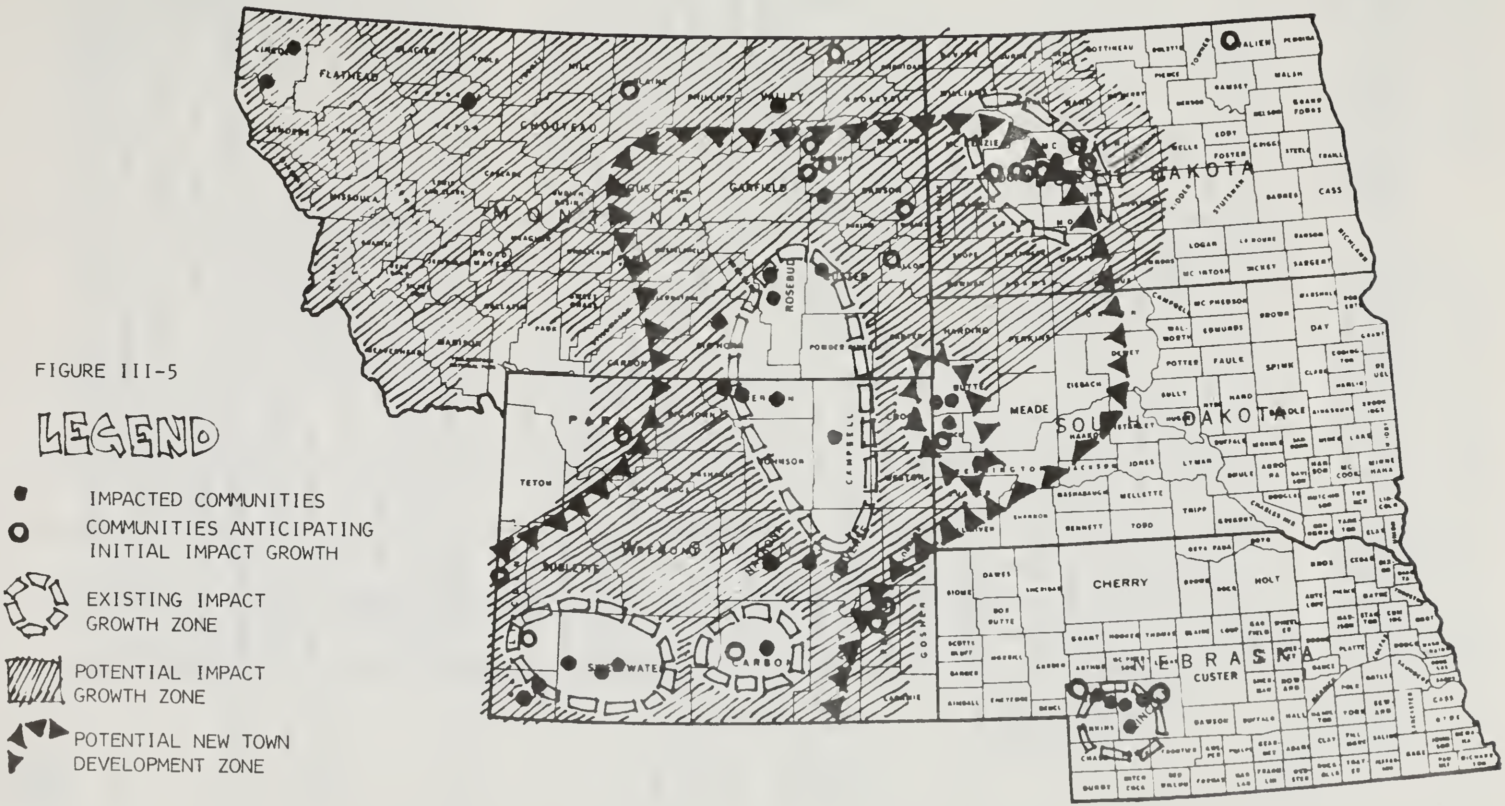


FIGURE III-5

PRIMARY ISSUES

Impact growth, as witnessed in the energy resource areas of the Old West Region, has been felt most keenly at two levels of government, i.e., at the town or municipal level and at the county level. Authorities in several of the currently impacted as well as those communities that are anticipating imminent impact growth were interviewed to determine the major problems that they will have to face, respectively. In some instances, subjective rankings of the severity of the problems were given. The issues and rankings are listed in Table III-5.

Based upon the above noted survey, the principal issues that emerged were housing, general utilities and schools. The major concern inherent in these three issues as well as with the others noted, is the need for related adequate planning and financing programs. Primary concerns related to housing are: What form should new housing take? Where should it be located? Should mobile homes be allowed to occupy vacant lots in single-family subdivisions? If so, should a time limitation be placed upon the required variance? Especially of concern regarding housing was the high development costs of lots (e.g., upward to $8,000 per ½ acre lot in Kemmerer, Wyoming), high construction costs (varying from approximately $35.00 to $40.00 a square foot for a modestly appointed square foot conventional house in Langdon, North Dakota) and the scarcity and high cost of construction loans.

The problems of substantial housing for large, temporary construction forces and their families and the spiraling costs of conventional housing has been addressed in some recently completed comprehensive plans. In the Big Horn County (Montana) Comprehensive Plan, it was suggested that "one way of providing housing for the highly mobile construction worker expected in large numbers in the 1980 and 1990 periods is through mobile homes. As much as 43 percent of the 1980 demand based on the mobility of the population could be for mobile homes; this would amount to about 3700 units."[3] The recently completed Buffalo, Wyoming comprehensive plan predicted that "the number of . . . families unable to afford new wood frame housing or modular housing will be about 50% of the increased

ENERGY RESOURCE CONSTRUCTION SITES

TABLE III-1A

	FOSSIL-FUEL ELECTRIC POWER GENERATION FACILITY	COAL GASIFICATION	OTHER	UNDER CONSTRUCTION	PROPOSED	PEAK CONSTRUCTION FORCE (YEAR)
LAKE SAKAKAWEA ENERGY COMPLEX						
1. MINNKOTA	X(440 MW)			X		750 (1976)
2. UNITED POWER	X(450 MW)				X	325 (1977)
3. MICHIGAN WISCONSIN PIPELINE (AMERICAN NATURAL)		X			X	2400 (1980)
4. MONTANA DAKOTA UTILITIES	X(440 MW)				X	800 (1980)
5. BASIN ELECTRIC III	X(440 MW)					1100 (1979)
6. NATURAL GAS PIPELINE OF AM. (TEXAS NATURAL)	X	X			X	3200 (1980)
BIG HORN/ POWDER RIVER BASINS ENERGY COMPLES						
7. MONTANA POWER	X(700 MW)			X		1450 (1975)
	X(1400 MW)				X	1500 (1979)
POWDER RIVER BASIN ELECTRIC ENERGY						
8. WYODAK (BLACK HILLS POWER & LIGHT AND PACIFIC POWER & LIGHT)	X(330 MW)			X		700 (1976)

families. These combined with other lower income in-migrants should limit some 60% of the new population to mobile homes for single family living."[4]

The issue of utilities revolves around the presence of old deteriorating water and sewer systems in many of the small communities under 1000 people. When subjected to the additional use pressures of impact growth, deterioration increases. The only alternative is for total replacement, because of the age and condition of those systems. A sub-issue is the need for extensive expansion of sewer and water lines to service the developing portion of communities. Expansion will require extra capital investments due to the extreme environmental situations in which many of those impacted communities are located.

The third-most important issue is adequate school facilities. One of the most difficult projections to make is that of school age populations in an impact growth situation, especially one resulting from a large "migratory" construction force. The primary problems relate to not being certain if the construction worker will bring his family with him and, if so, what will be the pre-school age probability of the construction worker's children. These two uncertainties make both the adequate planning of facilities and provision for adequate staffs very difficult. For example, the school population in Colstrip, Montana varied on a weekly basis for extended periods of time.

In addition to the three aforementioned issues, a common complaint among community leaders was that the major industrial and power plant facilities were being constructed outside their jurisdictional boundaries. Yet, the responsibility to furnish the housing and services to adequately maintain the labor force remained in the community.

In southwestern Wyoming, a comprehensive study developed by the Denver Research Institute has shown that the major problem in impacted communities is obtaining necessary revenues to meet the additional people-related demands. Critical needs of impact growth were: schools, utility distribution systems, recreation facilities, housing, cultural facilities, and health care and delivery systems. There was a very high turnover

ENERGY RESOURCE CONSTRUCTION SITES

TABLE III-1B

	FOSSIL-FUEL ELECTRIC POWER GENERATION FACILITY	COAL GASIFICATION	OTHER	UNDER CONSTRUCTION	PROPOSED	PEAK CONSTRUCTION FORCE (YEAR)
GREEN RIVER BASIN ENERGY COMPLEX						
9. PACIFIC POWER & LIGHT (JIM BRIDGER) X (2000 MW)	X(1500 MW) X(500 MW)			X		3000 (1973) 1200 (1978)
10. FMC CORP., ALLIED CHEM., TEXAS GULF, STAUFFER CHEM., CHURCH & DWIGHT (TRONA MINES)			X	X		1600 (1978)
11. UTAH POWER & LIGHT	X(860 MW)				X	850 (1978)
OTHER						
12. PANHANDLE EASTERN		X			X	
13. BASIN ELECTRIC	X(1500 MW)				X	
14. NEBRASKA PUBLIC POWER	X(600 MW)			X		1000 (1977)
15. NORTHERN NATURAL GAS (BURLINGTON NORTHERN)			X		X	
16. GLASGOW (AIR FORCE BASE)		X				
17. NORTHERN NATURAL GAS		X			X	400 (1979)
18. CANADIAN (UNIDENTIFIED)	X				X	
19. CANADIAN (UNIDENTIFIED)	X				X	

of qualified non-resident mineral workers, primarily because of the inability to provide an acceptable quality of life. Employee retention was a constant and expensive problem for private industry. The high employee turnover resulted in a need for additional people in order to meet scheduled deadlines. Additional people increased the scale of the impact problem.

PLANNING POWER

The five states in the Old West Region have developed similar legal frameworks for planning and land use control in the respective spheres of jurisdiction. The authority for planning and land use control by state governments is derived from the Tenth Amendment of the Constitution of the United States. The powers not delegated to the federal government, nor prohibited to the states are reserved to the representative states or the people by the Tenth Amendment.

These powers are implemented by the respective state legislatures but must conform to state and federal constitutions. The state may enact and enforce legislation under its police powers for the purposes of protecting public health, safety and welfare. To this end, state laws may interfere with a landowner's right to the use and enjoyment of his property, if it can be shown that this interference is for the purpose of the greater welfare of the general public. In all such cases the individual landowner must be given equal protection and due process of law under the Fourteenth Amendment of the U.S. Constitution.

Police powers are constitutionally vested in the state; not in local governments or administrative agencies. In order for cities, towns, counties, special districts or administrative agencies to make and enforce their own laws, in the form of resolutions, ordinances, or rules and regulations, they must be delegated the power to do so by the state legislature. If these political subdivisions have been given the needed authority, they can likewise regulate and plan for the use of private and public land.

ANTICIPATED IMPACT GROWTH COMMUNUTIES

TABLE III-2

(2) EXAMPLE OF A POTENTIAL MULTI-CYCLE IMPACT GROWTH COMMUNITY

STATE	COMMUNITY	1970 POP.	COUNTY
MONTANA	EUREKA (2)	1,195	LINCOLN
	CHINOOK	1,813	BLAINE
	SCOBEY	1,486	DANIELS
	CIRCLE	964	MCCONE
	WELDON		MCCONE
	(FLOWING WELLS)	--	MCCONE
	WIBAUX	644	WIBAUX
	EKALAKA	663	CARTER
	HARDIN	2,733	BIG HORN
	ASHLAND	150	ROSEBUD
	LODGE GRASS	806	BIG HORN
NEBRASKA	NORTH PLATTE	19,447	LINCOLN
	OGALLALA	4,976	KEITH
NORTH DAKOTA	UNDERWOOD	781	MCLEAN
	WASHBURN	804	MCLEAN
	BEULAH	1,344	MERCER
	HAZEN	1,240	MERCER
	DODGE	121	DUNN
	KILLDEER	615	DUNN
SOUTH DAKOTA	NEMO (2)	--	LAWRENCE
WYOMING	KEMMERER	2,292	LINCOLN
	AFTON	1,290	LINCOLN
	RAWLINS	7,855	CARBON
	MEETEETSE	459	PARK
	WHEATLAND	2,498	PLATTE
	GUERNSEY	793	PLATTE
	BUFFALO	3,394	SHERIDAN

In the Old West Region, all the states have delegated police powers to cities, towns and counties under which they have the right to develop land use plans and land use controls for their constituents. In addition certain special districts are given limited powers such as sanitary districts in Wyoming or school districts in all the Old West states.

The development of comprehensive plans and land use controls has traditionally moved forward to a sophisticated level in the larger cities such as Rapid City, Billings, Bismark, Casper, Omaha, etc. Zoning ordinances, subdivision ordinances, and mobile home park ordinances are three of the most widely used land use controls. Counties and smaller towns have traditionally been reluctant to develop land use plans and controls.

The general concept is embodied in planning commissions which advise elected officials on land use planning and control methods. Only the elected body can adopt ordinances, rules and regulations, etc. In Montana, North Dakota, South Dakota, and Nebraska, substate planning districts are now established in the Old West Region. The theory behind developing substate districts is to provide economy of scale and some uniformity in planning and land use controls. South Dakota, for example, has six planning and development districts that encompass a total of 64 counties and their respective cities and towns.

Another approach is the use of joint powers boards recently developed in Wyoming. Joint powers boards consist of two or more legal jurisdictions joining together to plan, create, expand, finance or operate capital facilities, etc. This mechanism allows the wealth of a county when mineral taxation occurs to be shared with a given city where people may prefer to live.

In summary, a legal framework for planning has been established in all the Old West States, but to what degree local governments have developed land use controls is another subject. Recently, counties and small towns in the Old West Region have taken steps to control land use as a result of people impact or threat of impact from mineral development. The state of the art is currently a mixed bag.

POPULATION TRENDS IN SHERIDAN CO. WYOMING

TABLE III-3

Source: Les Jayne, Director, Sheridan City/County Planning Commission (Telephone interview).

	1950	1960	% CHANGE 1950-60	1970	% CHANGE 1960-70	1973	% CHANGE 1970-73	1975	% CHANGE 1970-75
Sheridan	11,500	11,651	+1.3	10,856	-6.0	11,378	+4.8	12,500	+15.1
Ranchester	251	235	-6.3	208	-11.5	312	+50.0	416	+100.0
Clearmont	225	154	-31.6	141	-8.4	152	+7.8	200	+41.8
Dayton	316	333	+5.4	396	+18.9	427	+7.8	450	+13.6
Unincorporated	7,893	7,616	+1.04	6,251	-1.2	6,608	+5.7	7,000	12.0
Sheridan Co.	20,185	18,989	-5.9	17,852	-6.0	18,877	+5.7	20,565	+15.2

PLANNING RESPONSE

Planning for impact growth in the Old West Region is currently being considered by all levels of government as well as by private industry. At the federal level, the Department of the Interior and the Environmental Protection Agency are considering conducting regional environmental impact statements related to energy development and providing relevant development handbooks for local use. The EPA, additionally, is responsible for setting federal air and water quality standards which are exerting a considerable influence on the siting and development costs of energy resources and sewage treatment facilities throughout the region. (See Appendix)

Various other federal agencies such as the Economic Development Administration, Federal Energy Agency, Energy Research & Development Agency, etc., are either conducting or planning various studies or providing funding to deal with impacted growth.

At the regional level, the Northern Great Plains Resource Program recently completed an indepth overall analysis of potential mineral development and its possible effects on the life style and environment of the northern great plains region. The NGPRP is a cooperative federal-state program that includes representatives from major federal agencies, five state governments (Old West States) local governments and special interest groups. The resulting study is very broad in nature but does give the reader an excellent over view of potential impact in this region.

Recently, the governors of ten western states have banded together and formed the Western Governors Regional Energy Policy Office. Their primary purpose is to address regional issues and represent the region regarding development policies at the national level. Other regional bodies include the Federation of Rocky Mountain States (Montana, Wyoming, Colorado, Utah, and New Mexico) and the Old West Regional Commission. Old West Regional Commission is conducting investigations into the social, economic and environmental consequences of regional energy development as well as providing direct financial and manpower assistance to impacted counties and communities. Also, at the regional level broad brush impact

EXISTING MAJOR ISSUES

IN SELECTED IMPACT GROWTH COMMUNITIES

TABLE III-4

* (Initial Impact Growth Phase Past) ** (County Roads)
(Numbers) represent order of importance (X's) represent recognized issues

		Adequate Housing	High Housing Construction Costs	Adequate Schools		Adequate Utilities			Solid Waste	Adequate Medical		Adequate Law Enforcement	Adequate Fire Protection	Street Extensions/ Improvement	Adequate Recreational Facilities	Sources for Financing Basic Expansions Community Facilities/ Services	Availability of Convenience Goods	Availability of Personal/ Professional/Business Services
				(Facilities)	(Staff)	(Lines)	(Water Supply)	(Sewage Treatment)		(Facilities)	(Staff)							
WYOMING	Rock Springs	(1)				(3)		(3)		(2)								
	Gillette	(X)		(X)	(X)		(1)					(X)			(X)			
	Sheridan	(2)				(X)				(X)						(1)		
	Lyman(*)	(X)		(X)		(X)	(X)	(X)	(X)	(1)		(X)						
NORTH DAKOTA	Center	(X)		(1)		(X)				(X)		(X)		(X)	(X)			
	Langdon(*)	(X)	(X)	(X)	(X)	(X)	(X)	(X)		(X)		(X)	(X)	(X)	(X)			
SOUTH DAKOTA	Newell (*)	(1)																
MONTANA	Forsyth	(5)		(1)		(2)	(2)	(2)	(2)			(4)						
	Colstrip			(1)						(2)	(2)							
	Rosebud County	(7)		(1)		(3)		(3)	(5)	(6)		(4)		(2)**				
NEBRASKA	Hershey	(x)																

perspectives are being developed by research organizations such as the Upper Midwest Council.[5] The individual five states are providing prototype planning assistance and expert advice at the substate level. Through the various air, water, health, solid waste and general environmental departments of the five state governments, varying degrees of influence are being felt at the local level through project review and licensing procedures.

At the state level, all of the states in the Old West Region are responding to the changing times. The state of South Dakota recently reorganized its numerous state governmental agencies into a streamlined 13 member department council. The state of Montana re-wrote its constitution creating a maximum of nineteen departments of state agencies. The state of Wyoming recently enacted numerous pieces of legislation designed to meet industrial growth. The most significant pieces of Wyoming legislation were an Industrial Siting and Information Act, State Land Use Planning Act, State Subdivision Act, Wyoming Community Development Act and Coal Tax for Impact Assistance. The Wyoming State Land Use Act creates a state land use commission and staff whose function is to develop a state wide land use plan incorporating 23 counties and their respective cities and towns in individual land use plans. The legislature authorized a two year program of financial assistance to help the counties develop their own land use plans. Other states in the Old West Region have passed or attempted to create related legislation.

At the sub-state level, impact growth strategies are being developed by the multi-county planning councils or districts in Montana, North and South Dakota and Nebraska, and by city/county planning commissions, the Department of Economic Planning and Development and State Land Use Commission in Wyoming. In addition, EPA 208 Water Quality Planning Programs have been established on a multi-county basis throughout the Old West Region. A good example of the nature of these impact growth strategies is found in the recently completed DEPAD fiscal impact study on required capital facilities resulting from impact growth in the four-county Powder River Basin area in northeastern Wyoming.[6]

However, even with the aforementioned multi-level governmental attack on the basic issues of impact growth, the primary response to impact

ANTICIPATED MAJOR ISSUES

TABLE III-5

IN FUTURE IMPACT GROWTH COMMUNITIES

(numbers) represent order of importance
(X's) represent recognized issues

		Adequate Housing	High Housing Construction Costs	Adequate Schools (Facilities) (Staff)	Adequate Utilities (Lines) (Water Supply) (Sewage Treatment)	Solid Waste	Adequate Medical (Facilities) (Staff)	Adequate Law Enforcement	Adequate Fire Protection	Street Extensions/ Improvement	Adequate Recreational Facilities	Sources of Financing Expansions Basic Community Facilities/ Services	Availability of Convenience Goods	Availability of Personal/ Professional/ Business Services
WYOMING	Buffalo	(X)		(X)(X)			(X)							
	Kemmerer	(X)	(X)		(1)(1)(1)	(X)	(X) (X)							
NORTH DAKOTA	Underwood	(1)												
	Washburn	(1)												
	Beulah	(1)			(2)		(3)							
	Hazen	(1)			(2)		(3)							
MONTANA	Circle	(1)		(X)(X)	(XXXX)		(X)							

growth has been at the local (i.e., county and municipal) level.

In the Old West Region, (representing the tradition of a deep respect for mutually independent decisions among its residents) the presence of comprehensive planning at the local level is a comparatively recent phenomenon. Consequently, initial comprehensive planning and impact growth are occuring simultaneously. In some instances planning has even followed impact growth. What has resulted, in a sense, is what might be termed "crisis" planning, which is presently typified in the communities of Forsyth, Montana and Green River, Wyoming, by their attempts to cope with various new and expanding mining activities and related development.

The planning response of the selected communities and counties located within the impact growth zone of the Old West Region was reviewed in terms of existing (1) comprehensive land use plans, (2) zoning ordinances and (3) mobile home park development regulations. This review was preceded by telephone interviews with local officials and respective planning staffs. The communities and counties selected represent four of the five major physiographic regions of the Old West Region as well as representing one of the following situations: (1) previously impacted (2) currently impacted or (3) anticipating impact. The current status of planning response (in terms identified above) of the representative communities and counties in the Old West Region is indicated in Table III-6.

As demonstrated by the information in Tables III-6 - III-8, the current status of comprehensive plans, general zoning ordinances, and mobile home park development regulations, can be considered to be in infancy. For example, comprehensive plans and related general zoning still do not exist for such potentially high impact growth counties as Converse, Johnson, Sheridan and Campbell counties in Wyoming in addition to most of the potentially high impact growth counties in Montana, exemplified by Rosebud and McCone counties. Comprehensive plans, zoning ordinances and mobile home park development regulations, where existing, generally have been just recently adopted. Where no mobile home park development regulations have been adopted, mandatory state standards, when existing, are followed. For example, the highly impacted Sweetwater County, not possessing mobile

TABLE III-6

PLANNING RESPONSE

OF SELECTED COMMUNITIES AND COUNTIES LOCATED IN THE IMPACT GROWTH ZONE OF THE OLD WEST REGION	COMPREHENSIVE LAND USE PLAN	ZONING ORDINANCE	MOBIL HOME PARK DEVELOPMENT REGULATION
MONTANA			
ROSEBUD	NO	NO	1975 (4)
BIG HORN COUNTY	1974	NO	NO
FORSYTH	PENDING	PENDING	1966 (?)
COLSTRIP	1973	NO	1974 (ROSEBUD CO.
CIRCLE	PENDING	1969	1975
WYOMING			
JOHNSON COUNTY	NO	NO	(2)
SHERIDAN COUNTY	NO	NO	(2)
CAMPBELL COUNTY	NO	NO	1974
SWEETWATER COUNTY	1972	(1972) (4)	NO
SHERIDAN	1954	1961	1975 (4)
GILLETTE (CAMPBELL PLANNING DISTRICT)	PENDING	1968	(1)
ROCK SPRINGS	(1975) (4)	1976 (4)	2976 (4)
KEMMERER	NO	1955 (?)	1955 (?)
LYMAN	PENDING	1974	(1)
BUFFALO	1975	1963	1967 (3)
NORTH DAKOTA			
MCLEAN COUNTY	1972	1975	(1)
MERCER COUNTY	1968	1975	(1)

(1) INCORPORATED IN GENERAL ZONING ORDINANCE
(2) DRAFT RESOLUTION
(3) CURRENTLY BEING UPDATED
(4) UPDATE
(5) WYOMING STATE LAND USE PLANNING ACT REQUIRES PRELIMINARY PLANS AND ORDINANCES BE DRAFTED BY 1 JULY 1977

home park development regulations, is nonetheless bound by the following state guidelines: General and Special Standards Governing Mobile Home Parks (administered by the State Department of Health and Social Services); Wyoming Water Quality Rules and Regulations (administered by the State Department of Environmental Quality); and Minimum Standards for the Fire Prevention in Mobile Home Parks (administered by the State Department of Fire Prevention and Electrical Safety).

A closer analysis of comprehensive plans, general zoning ordinances and mobile home park development regulations from selected communities and counties (Table III-7) disclosed a growing awareness of the need for a comprehensive growth impact strategy for future develpment. This emerging awareness is demonstrated in the impact growth population projections and analysis in the recently completed comprehensive plan for Buffalo, Wyoming, the provision for temporary mobile home parks in the recently revised Gillette, Wyoming zoning ordinance and the provision for construction camps in the recently adopted zoning ordinance of McLean County, North Dakota.

Generally, no comprehensive detailed impact growth strategies are outlined in the present planning tools of the communities and counties of the Old West Region and the only type of mobile/temporary facility regularly addressed is the mobile home.

In assessing some positive steps taken by local government and industry to alleviate impact growth problems, in some instances meaningful analysis and research has occured after impact growth had begun. The previously mentioned Sweetwater County: A Classic Problem in Growth Management by Denver Research Institute which was funded by private industry is fundamentally an excellent analysis of the problems that occur during rapid growth. One of the major concerns identified in the study was finding additional sources of revenue for new capital facilities. The local governments in Sweetwater County responded by asking the residents to pass an additional 1% sales tax at the county level. The City of Rock Springs gained nearly $136,000 in additional sales tax revenue in the month of July, 1975 alone. Other means of addressing growth problems were the establishment of the Sweetwater County Priority Board (composed of elected

PRINCIPAL ELEMENTS

of Mobile Home Park Development Regulations in Three Representative Counties Located in the Impact Growth Zone of the Old West Region

TABLE III-7

	Year Adopted	Minimum park size	Density Standard	Open Space Standard	Minimum Lot Size	Minimum Lot Division	Minimum Setback	Unit Spacing	Central Utilities (Sewer/Water)
Johnson Co. (Wy)	Draft (1-1-76)	Yes (in terms of # of units, i.e., 3 or more)	(Implied)	Yes	Yes	Yes	Yes	Yes	Yes
Sheridan Co. (Wy)	rev. draft (1-1-76)	Yes (in terms of # of units, 2 or more)	(Implied)	Yes	Yes	Yes (MDTA)	Yes	Yes	Yes
Campbell Co. (Wy)	1974	Yes (in terms of # of units, i.e., 2 or more)	(Implied)	Flexible	Yes	Yes (Width)	Yes	Yes	Yes

officials of Sweetwater County and City of Rock Springs, Green River and others). The board's function is prioritizing needed capital facilities and procuring necessary funds. In addition all the major companies in southwestern Wyoming formed the Southwest Wyoming Industrial Association (advisory group to local communities and a source of limited funding).

In the case of Wheatland, Wyoming, a task force made up of industry, state and local government agencies and special interest groups was organized to plan for the impending growth impact associated with a proposed 1500 MW Laramie River Station Power Plant. The task force has been working on developing a comprehensive plan in conjunction with the local planning office, identifying capital facility needs, (types and numbers of housing, schools, etc.) and procuring funding to pay for needed community facilities and services. In North Dakota, regional planning councils exist which conform with established Resource and Conservation Districts thereby eliminating duplication of efforts. Consolidation of manpower and funding sources helped to expedite planning response to pending impacted growth.

LAST WORD

The planning response in the Old West Region has been slow to develop at all levels of government. However, recent notoriety of the negative socio-economic impacts associated with rapid growth has spurred all levels of government and private enterprise to open lines of communication and take decisive steps towards smoothing out the consequences of impact growth. Planning in the Old West Region may be in its infancy but it is certainly gaining momentum.

TABLE III-8

PRINCIPAL ELEMENTS

OF ZONING ORDINANCES RELATED TO THE SITING AND USE OF TEMPORARY/MOBILE FACILITIES OF A REPRESENTATIVE COMMUNITY AND COUNTY IN THE IMPACT GROWTH ZONE OF THE OLD WEST REGION

	DESCRIPTION	MERCER COUNTY, N.D.	GILLETTE, WYOMING
	YEAR ADOPTED	1974	1968
	ZONING DISTRICT MAP	YES	YES
	MOBILE HOMES	YES	YES
	OTHER	NO (1)	(2)
MOBILE HOME PARK REGULATIONS	MINIMUM PARK SIZE	YES (5 ACRES)	YES (2 ACRES)
	DENSITY STANDARD		YES (8 UNITS PER GROSS ACRE)
	OPEN SPACE STANDARD	YES	YES (3600' PER UNIT)
	MINIMUM LOT SIZE	YES	YES
	MINIMUM LOT DIMENSIONS	YES	YES
	MINIMUM SETBACK	YES	
	CENTRAL UTILITIES (SEWER/WATER)		YES
CONSTRUCTION "CAMPS"	SINGLE FAMILY DWELLING STANDARDS	YES	NO
	MOBILE HOME LOT STANDARD	YES	NO
	DISMANTLING (RECLAMATION) PLAN REQUIRED	YES	NO
	GENERAL STRUCTURAL SITING STANDARDS	YES	NO
TEMPORARY MOBILE HOME PARKS	MINIMUM PARK SIZE	NO	YES (2 ACRES)
	DENSITY STANDARD	NO	YES (12 UNITS PER GROSS ACRE)
	OPEN SPACE STANDARD	NO	YES
	MINIMUM LOT SIZE	NO	YES (2700'/ UNIT)
	CENTRAL UTILITIES (SEWER/WATER)	NO	YES
	USE TERMINATION PLAN REQUIRED	NO	NO
	PLANNED UNIT DEVELOPMENT (PUD)	YES	YES

1. CLAUSE RELATING TO "TEMPORARY (USE) PERMITS" DOES NOT INCLUDE MOBILE/TEMPORARY USES IDENTIFIED IN THIS REPORT.
2. CLAUSE RELATING TO "TEMPORARY STRUCTURES INCIDENTAL TO CONSTRUCTION WORK," OTHERWISE NOT DEFINED.

FOOTNOTES

1 Dennis Watt, Planning Director, Sweetwater County, estimated that approximately fifty separate impact studies have been conducted within the last few years in Sweetwater County alone, the most comprehensive being a recent 3 volume study conducted by the Denver Research Institute entitled: Sweetwater County - A Challenge to Growth Management.

2 However, significant federal assistance for impacted communities and counties is currently available in terms of insured construction loans, matching project grants and "no-strings-attached" grants as noted in Appendix E. Additionally, various recently imposed and proposed state coal development and impact growth taxes (See also Appendix E) on industries plus large increases in the industrial tax base of many of the impacted counties will serve as substantial sources of funds. Also, a potentially significant source of funds is direct aid by the new resident industries.

3 Big Horn County Planning Board (Intermountain Planner, Inc., Billings, Montana), Big Horn County Comprehensive Plan, 1974 - 1995, p. 146.

4 Buffalo-Johnson County Planning Office, Comprehensive Plan: Buffalo, Wyoming, 1975, Buffalo, Wyoming, p. 23.

5 Upper Midwest Council (Michael J. Murphy), Northern Great Plains Coal, Issues and Options for Supplies and Users, Minneapolis, Minnesota, July, 1975.

6 Wyoming Department of Economic Planning and Development, Capital Facilities Study: Powder River Basin, Cheyenne, Wyoming, April 1, 1974.

STATE OF THE ART

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INTRODUCTION

"State of the Art" refers to where man and technology are today. This section discusses the "State of the Art" of utility distribution and collection networks, architectural structure types, and how the communities of Colstrip, Montana and Lyman, Wyoming have handled impact growth. The examples of Colstrip and Lyman will show how some architectural and engineering elements (i.e. sewerage systems, pre-engineered metal buildings, etc.) have been utilized in real situations.

INFRASTRUCTURE

For the purpose of this report we will define infrastructure as the utility distribution and collection network (water, sewage, etc.,) of a community. The infrastructure and related treatment facilities are obviously an important element in any modern community. The infrastructure is more critical in a temporary/mobile community because portability is a major requirement. However, previous to 1970 no infrastructure systems were designed or manufactured with portability in mind. Engineers of the past never had to deal with portability as a design constraint because cities were assumed to be permanent. Until recently the basic considerations of infrastructure, except for power distribution, were essentially the same as 2,000 years ago. To demonstrate the lack of progress regarding temporary water supply technology and sanitary engineering a brief history of public services will introduce discussions on water distribution and waste water collection, water and waste water treatment, and solid waste disposal. A portable piping system will also be discussed.

WATER SUPPLY

In Mesopotamia, Assyrians constructed sloping tunnels to bring water from the hills to the plains. This system's origin was in Armenia. The Etruscans (Northern Italy) constructed their homes around a central atrium (courtyard) which contained a cistern to collect rainwater. The Romans further developed the aqueduct and cistern with great success (i.e. Venice, Italy and Dubrovnik, Yugoslavia). A dramatic example is the ruins of Pergamon (Bergamma, Turkey) a large Helenistic Roman city constructed in 180 B.C. From the hilltop acropolis, one notices a large aqueduct coming into the city and disappearing over the horizon. This system carried water at a pressure of 250 psi. This amazing pressure was accomplished by passing metal pipes (lead or bronze) through hollowed stones.

"Generally Romans had to build their aqueducts on elevated structures because the water flowed in an open channel instead of in an underground pipe as with us. Flowing in an open channel, the water depended on gravity to move it all the way from the source to the point of distribution."[1]

The Romans did not use pressure pipe exclusively because pipe making was a relatively new technique. Workable material was limited and above ground aqueducts would easily show leaks.

After the fall of Rome, water supply technology developed very slowly if at all. "In Paris during the High Middle Ages lords and royal officers tapped into public lines to bring water into their own residences. Finally in 1600 the King of France levied fees on the private users to support the water system."[2]

Developments in metallurgy and industrialization led to more efficient pressurized piping systems for the distribution of water. Generally cast iron pipe was and still is used for the transmission and distribution lines in most American cities. Advances in organic chemistry opened up a new horizon with the development of plastics. Polyvinylchloride pipe (PVC) is widely accepted for use as main lines to service hook-ups. (In retrospect water distribution technology has developed but the basic principles of water supply distribution goes back to Roman times.)

Today "water distribution systems are ordinarily designed to adequately satisfy the water requirements for some combination of domestic, commercial, industrial, and fire-fighting purposes. The system should be capable of meeting the demands placed on it at all times and at satisfactory pressures. Pipe systems, pumping stations, storage facilities, fire hydrants, house service connections, meters, and other appurtenances are the main elements of the system."[3]

There are basically three types of distribution systems: grid, branching, and combination grid/branch. The grid system consists of loop feeders which can supply an area from more than one direction and has a natural self-flushing action. Branching systems are directional and the dead ends tend to build up residue.

Maintenance of a required water pressure is a basic design factor of any water system. "Pressure demands vary with use, i.e. commercial 60 to 75 psi and residential 40 to 50 psi. Due to the advent of pumper trucks high line pressure is not necessary for fire fighting yet a 6 inch diameter pipe is a minimum requirement."[4]

Distribution reservoirs provide service storage to supplement line pressure during normal operation and emergencies. Pumping equipment is a major element in the water transportation system. The primary types of pumps used are: centrifugal and displacement. Pumps are normally driven by electric or fossil fuel motors. Other operating characteristics are available from pump manufacturers.

"The design of a water distribution network involves the selection of a system of pipes so that the predicted design flows can be carried with head losses which do not exceed those deemed necessary for adequate operation of the system."[5]

System layout is controlled by street patterns, topography, scale (size) and type of development, location of treatment and storage facilities. Additions to existing systems undergo further consideration because they have to be analyzed for performance.

SEWERAGE: HISTORY

"The earliest evidence of waste-water disposal dates back 5,000 years ago to Nippur in Sumeria. Water taken from wells or cisterns conveyed the wastes from palaces and residential districts."[6] In Rome the first sewer evolved into the Cloaca Maxima which was primarily a storm-sewer to drain rain water. "Used water from baths and industrial establishments was channelled to flush public latrines into Cloaca Maxima."[7] Direct connections were also made to this main sewer to dispose of wastes from a few palaces and residences. "It is astonishing to note that from the days of early Rome to the middle of the 19th century there was no marked progress in sewerage."[8] In the expanding cities of the industrial revolution poor sanitary conditions were common place. In London for example, the streams and rivers in the area had become polluted because human excrement was discharged into existing storm sewers which flowed into natural watercourses. An outbreak of cholera killed over 25,000 people in two years due to a contaminated water supply. "The solution was varying degrees of treatment as presently practiced in Europe and America, dependent upon the capabilities of the receiving stream of lake to take the load."9

SEWERAGE: TODAY

Traditionally sewer installations are gravity flow. A new method has been developed in Oregon due to the undulating topography. A brief discussion of this pressurized sewer system will follow a summary of the gravity flow system.

The layout of a sewer system will depend upon locations of roads, buildings, and other utilities, topography, soil types, and maximum drain depths. Systems will generally follow natural topography to avoid excessive excavation. Structure (buildings) connections should remove wastes at a 2% grade and flow into collecting sewers. The collecting sewer gather flows from structures and convey fluids to the interceptor sewer. Interceptor sewers transport flows from the collectors in the natural drainage basin to the treatment facility or disposal. The essential elements of hydraulic design require that peak design flows be carried by the pipe flowing full at velocities great enough to prevent deposition of solids . . . to avoid problems the gradient must not change abruptly or slope in a direction adverse to the flow at changes in horizontal direction.[10]

Collector and interceptor sewers can be constructed of the following: cast-iron pipe, vitrified clay pipe, concrete pipe, and recently polyvinylchloride sewer pipe.

The pressurized sewer system is made up of basically the same elements as the traditional gravity flow system. The major difference is that the flow is under pressure which means pumps are necessary. Structure connections can either be gravity flow to a common sump with pump or the sump and pump can be located adjacent to each structure. From the sump pump the fluid is pressurized and forced into the collector sewer, etc. This system will be discussed in more detail in the 'Design Criteria' section.

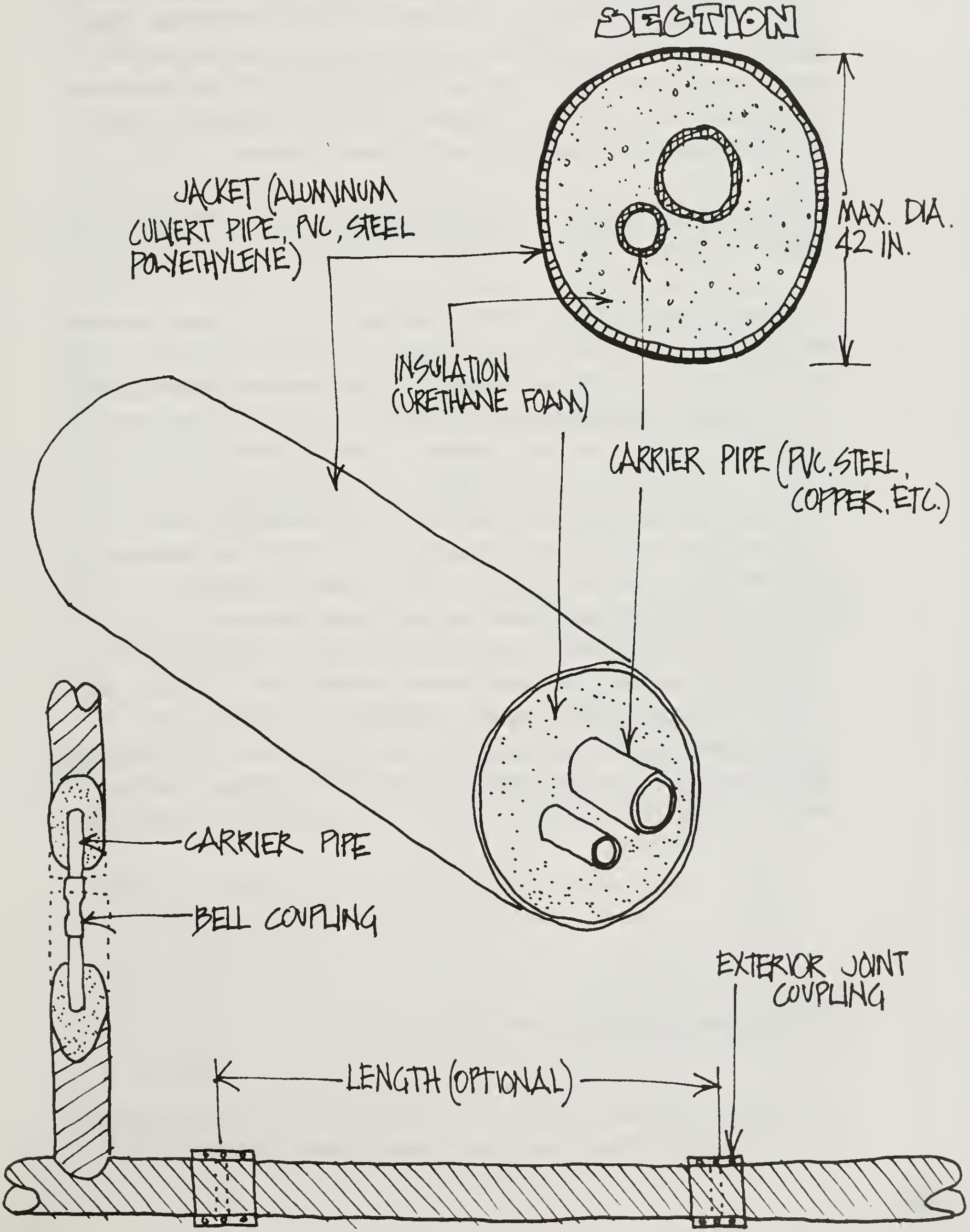
PORTABLE PIPING

The concept of portable infrastructure systems has developed into reality with the construction of the Alaskan pipeline. A limited number of companies currently manufacture modular, insulated pipe systems. The most popular system consists of corrugated culvert-type pipe which can contain almost any type of pipe (i.e. copper, cast-iron, P.V.C., etc.), within its foamed (polyurethane) core. The method is very flexible as to what can be placed in the corrugated pipe. Numerous pipes containing different utilities can be set inside. The type of joints connecting the carrier pipes is also variable (i.e. threaded, welded, bolted, slip coupled, etc.). The corrugated exterior skin is quite structural and it can be supported above ground or buried beneath ground.

The portable piping system described above has been primarily used as

PORTABLE PIPING SYSTEM

FIGURE IV-1


SECTION
JACKET (ALUMINUM CULVERT PIPE, PVC, STEEL POLYETHYLENE)
MAX. DIA. 42 IN.
INSULATION (URETHANE FOAM)
CARRIER PIPE (PVC, STEEL, COPPER, ETC.)
CARRIER PIPE
BELL COUPLING
EXTERIOR JOINT COUPLING
LENGTH (OPTIONAL)

main transmission and collection piping. The flexibility of the system is an important design factor. One pipe or line could contain sewer, water, power, and telephone or any combination of distribution lines. The service lines from dwellings or other structures to the mains should be by conventional underground installation but the main can be easily installed, removed, and reused. Further discussion of the possibilities of this system is in the 'Design Criteria' section.

WATER TREATMENT

In recent history water has been recognized as a vital natural resource. The demand for water has increased greatly in the last 40 years. This ever increasing demand has placed pressure on existing water supplies. Water management deals with a broad range of available water resources, everything from waste water to aquifers. The treatment of any form of water is recognized as a major element of water management. For this reason water and waste water treatment will be discussed together. There are three basic types of operations involved in the treatment of water and waste water: physical treatment, chemical treatment and biological treatment (waste water only). These processes will be discussed in the following sub-sections along with the concept of treating waste water effluent to obtain potable water. It should be noted that the design of a treatment operation is based upon the following criteria: evaluation of the quality of the water to be treated, establishment of a quality standard for the final effluent, and selection of appropriate processes to meet the final effluent standard with efficiency and economy.

PROCESSING

The physical treatment process involves some of the earliest water and waste water treatment methods known to man. Generally the first operation in treatment plants is screening. The opening size of the screens will vary from coarse to fine depending upon the origin of the water or sewage solids size. Comminutors (cutting screens) are only used to chop up sewage solids. Mixing and agitation are other physical operations. "Mixing may be defined as the blending of constituents to some desired state of uniformity. Agitation is an operation whose major function is to promote fluid turbulence."[11] Continuous and rapid are the usual mixing methods. Flocculation is an operation used to promote fluid agitation. Through agitation suspended particles in the fluid collide, coagulate into large particles, and settle out (precipitation). Flocculation reduces turbidity in the water. Sedimentation is an operation in which flocculated and nonflocculated particles are removed from the liquid. Filtration is another operation in which water and suspended matter are separated. There are basically three types of filters: granular (sand), diatomaceous earth (pressure operated), and microstraining (fabric collects microorganisms).

The quality of water or waste is to a large degree dependent upon the solids present in the fluid. Chemical treatment involves both chemical reactions and electro-chemical applications to control various dissolved solids. It is important for water to be stabilized to prevent corrosion and chemical deposits in pipes. For example, iron should be removed from water to prevent rust and calcium should be stabilized to provide a thin corrosion protective coating on metal pipes without excessive build-up. Water softening reduces dissolved solids which affect taste, and detergent action. Softening is usually achieved by ion-echange or lime-soda-ash processing.

Biological-treatment processes provide environments in which organic wastes (sewage) can decompose at maximum rates. One basic biological treatment system is the activated sludge process. In this process biologically active growths are continuously circulated and contacted with organic waste (eaten by micro organisms) in the presence of oxygen in the form of air bubbles injected under pressure. Trickling filters are a treatment system which have received wide application. In this process waste is brought into contact with air and biologic growths via percolating waste liquid through artificial beds of pourous material (to which the micro organisms cling). "Oxidation ponds or lagoons are shallow basins used for the purpose of purifying waste water by storage under climatic conditions that favor the growth of algae. The conversion of organics to inorganics or stabilization in such ponds results from the combined metabolic activity of bacteria and algae."[12] This photosynthetic process is another form of waste treatment. Digestion is a later stage in waste treatment. The residue or concentrated organic solids removed from sewage either through primary sedimentation, activated sludge processes, or trickling filters, is broken down to a simpler state. Volatile organic matter is reduced through a series of procedures to basically carbon dioxide, methane, and water.

WASTE WATER REUSE

The practicality of using treated waste water as an alternative water supply of a community is dependent upon the quality of treated sewage effluent and availability of other water sources. Treated waste water is actually quite widely used by many communities today. Communities located downstream on a river who obtain their water from the river would be treating water or effluent from a large industrial city upstream, although the effluent would be diluted and treated by the water body through natural processes.

"Presently waste water is used for: (1) irrigation, both agricultural and lawn, (2) industry, (3) aquifer recharge, (4) recreation, both contact and non-contact, and (5) for domestic potable supply."[13] In regards to a temporary/mobile community located in an energy development area, waste water could be used for any of the above purposes.

There are several approaches a community could take to utilize treated waste water: (1) direct use for all community needs, (2) indirect use via aquifer recharge, (3) non-potable use such as industry or recreation, and (4) dual-pipe systems in which fresh and treated effluent are piped to consumers. Aquifer recharge could be a practical application in the Old West Region. Many people use aquifers for their water supply and recharge could supplement low volumes during the summer months. When a community is located near an energy plant requiring cooling towers, waste water from the community could provide a source of water. Another industrial use would be to use the effluent as the transport media in a coal-slurry pipeline. A dual pipe system could also be feasible if water sources were limited. The community of Midwest, Wyoming utilizes a dual pipe system although a natural source is used for both supplies. Treated, potable water and untreated water are pumped to residences.

SOLID WASTE DISPOSAL

In the previous sub-section on water treatment the processing of sludges was not discussed. The processing of sludge involves separating water from the solid waste. This can be accomplished by several methods: drying beds, vacuum filtration, or centrifugation. The major problem in sludge processing, however, is disposal of the solid waste. Garbage, trash, etc., are also classified as solid wastes. The average person produces about 3 pounds of trash and .5 pounds of human waste everyday. The following text points out the current methods of disposing of this waste.

To illustrate environmental engineering progress; "The early cities of Mesopotamia had neither sewers, garbage disposal, nor trash collection, rubbish accumulated and constantly raised the level of the streets. Older homes could be distinguished by the fact that their entrances were below street level."[14] Today trash collection is adequate in most cities but solid waste disposal is still a controversial environmental issue.

The American Society of Civil Engineers defines sanitary landfill as a method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary.

The advantages of a sanitary landfill are:

- Use operating equipment which is relatively inexpensive and can also be used in other municipal operations.
- Reduce rodent and vermin breeding (a nuisance found at incinerators and open dumps).
- Can accept most of the solid waste volume generated by a community except bulky trash, raw sewage sludge, and garbage.
- Avoid serious health threats represented by open burning and dumping.
- Can be put into operation quickly.

Even though this method of solid waste disposal is widely used and most economical, it can be a wasteful process in which many potentially reclaimable resources are buried.

The second most popular method of solid waste disposal is incineration. Incineration simply involves the burning of wastes. The problems with this operation are:

- Contemporary incinerators meet E.P.A. air quality standards but the atmosphere is still being polluted. Cost associated with air pollution abatement usually makes incineration uneconomical.
- The ash remaining after combustion has to be removed. Ash could be used as construction fill but most communities dump it into landfills.
- A high initial investment is required and most units are not very portable.

Several cities i.e. Dusseldorf, Paris, London, Osaka, St. Louis, and Nashville, are burning wastes to generate steam or electricity. Although the initial expense is high, the equipment can be amortized by selling energy.

Another method of dealing with solid wastes as a resource instead of a nuisance: resource recovery or composting . . . "Europe has had a number of composting plants and the method is recognized as an effective waste treatment alternative to landfill and incineration."[15]

The composting process sets up a systematic materials-handling procedure for solid wastes. The operations of a large scale composting plant are as follows:

1. Reception of the refuse: hopper with conveyors for trucks to unload.
2. Sorting: removing materials for which there is a commercial demand. Such materials may be rags, metal cans, hard plastics, paper, etc. These are segregated mechanically, magnetically or manually, then taken to scrap dealers.
3. Preparation of the compost: shredding, pulverizing, or grinding to make decomposition easier and faster.
4. Stabilization area: open or enclosed location where garbage actually "purifies" itself of any disease germs, harmful parasites, etc. In this stage controls measure temperature and regulate air and moisture in the refuse.
5. Removal of material from stabilization area: treated compost can be stockpiled on small acreage and used as needed. Depending upon regional conditions, compost can be used to reclaim public or private lands as an ingredient in fertilizer, or as raw material by industry.

The initial equipment operation is expensive as opposed to a sanitary landfill but with this method natural resources are conserved through recycling. This natural process avoids pollution, and every by-product is marketable (depending upon production volume).

STRUCTURE TYPES

This sub-section deals with structure types currently manufactured which could be used for the construction of a mobile/temporary community. Methods of transporting these structures will also be discussed.

Structures in the community will enclose a variety of activities and the structure should correspond to the activity. This discussion will be broken into pre-fabricated housing, long span systems, and an explanation of the manufacturers' chart.

PRE-FAB HOUSING

Pre-fabricated housing consists of three basic types: mobile, modular, and component. Mobile structures are essentially mobile homes. Modular construction consists of enclosed spaces fabricated at a factory and set-up at the site such as double wide mobile homes. A component system consists of structure parts fabricated off site and assembled on site such as pre-fabricated residential construction. Component systems can also incorporate modules, i.e., utility cores into the building.

Pre-fabricated construction has been in existence for over a hundred years. The Eiffel Tower is a pre-fabricated component structure. To date in the United States the mobile home industry has been the only pre-fab industry to successfully market it's product. The growth of this industry is the result of many factors. A major factor is the portability of the mobile home. A mobile home is complete from carpeting to garbage disposal. It also requires no permanent foundation and is constructed on a transport undercarriage for easy movement. Mobile homes appear to be the best solution to the problem of providing temporary/mobile housing today.

Component and modular housing construction are not as mobile as mobile homes because their construction involves more connections that have to be disconnected or reattached; consequently more labor and time is involved. Currently the only proven modular housing system is the double wide mobile home.

The next step is to select a mobile home manufacturer whose units offer quality and least cost in comparison with units of similar quality The sections 'Design Criteria' and 'Codes and Standards' will help establish some selection requirements. Shipping expenses incurred from long distance hauling will help expedite selection. Selection is difficult because there is a large number of mobile home manufacturers in the country.

Mobile homes can range from $10/sq. ft. to $25/sq. ft. Generally the more expensive a home is the better the construction, but this is not always the case. There are companies that consistently produce a quality mobile home at fair prices. Materials and methods of construction vary considerably and these should be investigated carefully. Areas where problems have occurred in past production are:

ELECTRICAL	o Branch circuit malfunctions due to wiring methods o Poor quality of installation and manufacture of lighting fixtures and receptacle outlets.
HEATING	o Accessibility of hot water heaters. o Problems with venting and combustion air systems
STRUCTURAL	o Rain leaks through exterior covering primarily around windows, doors and roof. o Excessive heat loss through exterior walls.
PLUMBING	o Poor quality of installation and manufacture of toilets and various fixtures. o Loose water pipe connections.[16]

LONG SPANS

Long span systems will not be necessary for many enclosures yet some public spaces will require this type of construciton i.e. gymnasiums, auditoriums, stores, etc. The following long span system types: air structures, space frame/truss, pre-engineered metal building, and domes can span distances from 30 ft. to 400 ft.

An air structure is a dynamic operating system which uses design and materials much differently than a conventional rigid building. Air structures offer the longest clear span system currently available. The structural makeup and shape of air structures vary. The flexible, elastic envelope tends to take a spherical shape, making it impossible to provide flat surfaces. The system consists of the envelope (exterior skin), inflating and/or air supply system, base, and sometimes an airlock to control access and egress.

Air structures consist of several types:

Air-Supported Structures consist of a membrane which is supported by a pressurized space enclosed by the membrane.

- Single membrane structure
- Reinforced membrane structure (cable)

Air-inflated Structures utilize air-inflated structural elements to support the enclosing membrane. The enclosed area is not pressurized and no special door provisions are needed to control leakage.

- High pressure tube structure
- Dual wall structure

Hybrid Air Structures combine elements of the aforementioned air structure type or are used with other structural supports.

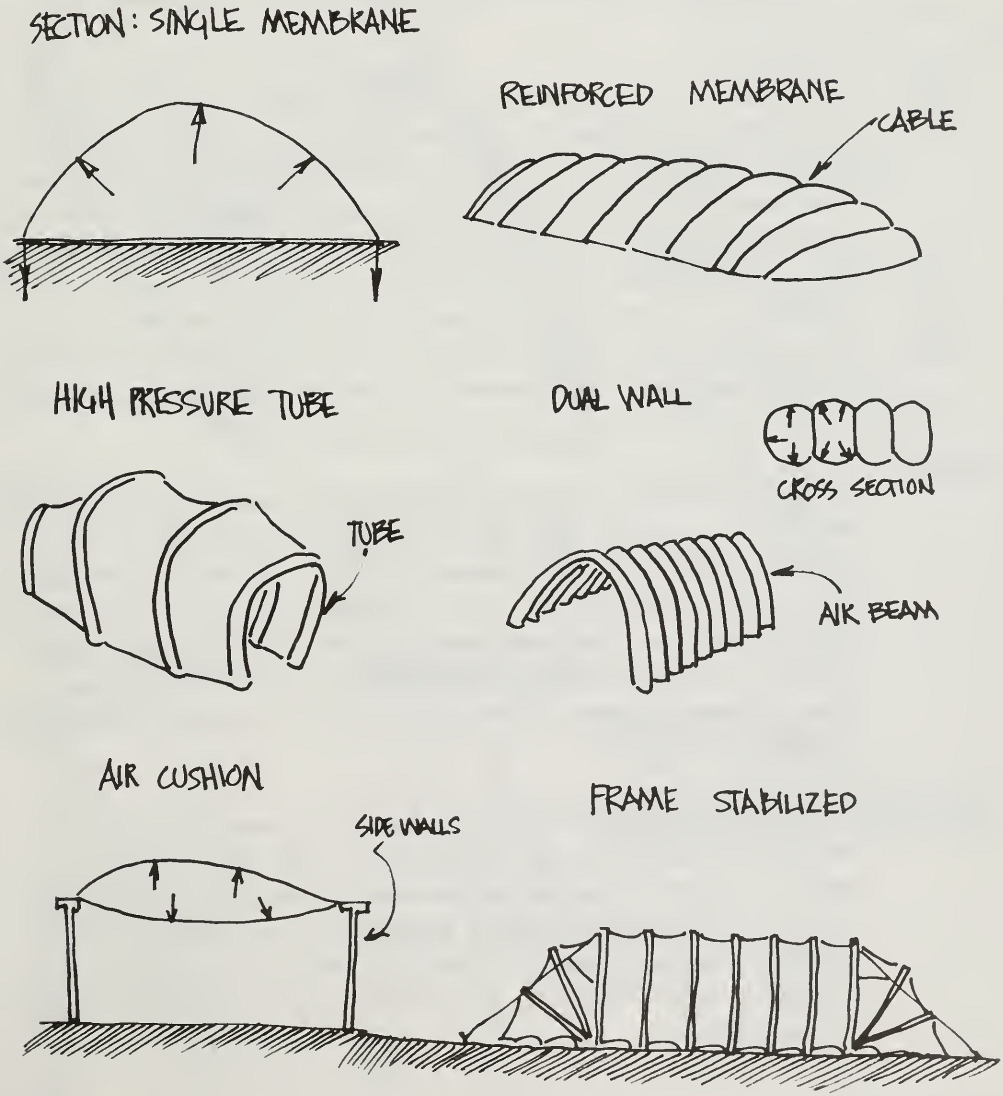
- Air cushion structure
- Frame stabilized air structure

There are several advantages of air structures. Air structures are designed to enclose a variety of activities. Systems can be very portable in relation to the volume of enclosure because the elements are lightweight. The costs range from $3 to $35/sq. ft. depending upon envelope fabric and mechanical equipment. The average cost is generally inexpensive at $5 to $6/sq. ft.

A space frame/truss is a long span roof system worthy of consideration. Several factors make it desireable for use as part of a temporary/mobile structure. It's lightweight facilitates both installation and portability. Members can be assembled into sub-assemblies on the ground and lifted into place or assembled in place. Roofing, ceiling, and mechanical distribution elements can be incorporated within a subassembly which would speed assembly and disassembly. The system is made up of standard components so members are easily reuseable. The

AIR STRUCTURE TYPES

FIGURE IV-2



vertical supports for the space frame can vary from: point support, cross support, perimeter support, and parallel supports. The positioning of these vertical supports under the frame is also flexible. For clear spans up to 40 ft. under normal roof loads which require no member reinforcement frames cost between $2.50 and $3.50/sq. ft. A major drawback of this system is the large number of connections involved in assembly, but an efficient sub-assembly design could remedy this problem.

Another type of long span structure is pre-engineered metal buildings which are a rigid frame structure made up of pre-fabricated components. Building components are computer designed and fabricated in automated manufacturing plants. The result is an efficient use of materials and minimal on-site labor costs since most work is completed in the factory. Overall construction time is reduced because during the time structural components and modular wall systems are being fabricated the site is being prepared and foundation poured. Transport of building components is relatively simple and inexpensive. One semi-truck can haul a 10,000 sq. ft. building.

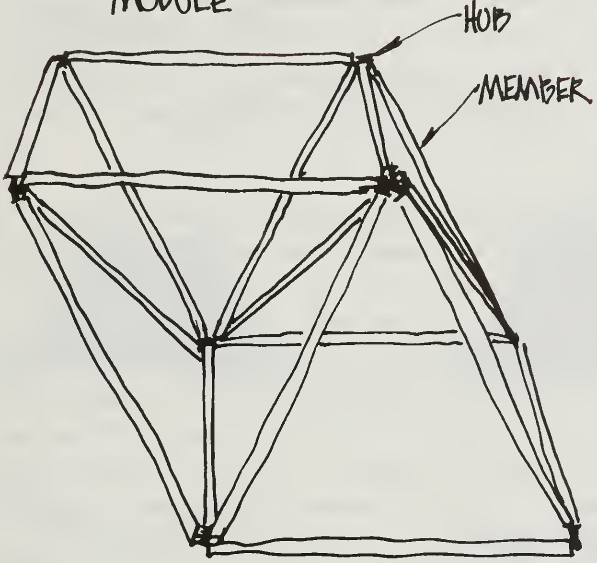
Pre-engineered metal building systems do have drawbacks for temporary/ mobile use. Heavy equipment may be necessary for erection and disassembly of the structural framework. Reuse of currently manufactured roof and wall panels may be limited because of repeated screw connections and poor handling. The installation of plumbing, electrical, and mechanical equipment will precede according to normal construction times and reuse of conduit, ducts, piping, etc., may not be economically feasible.

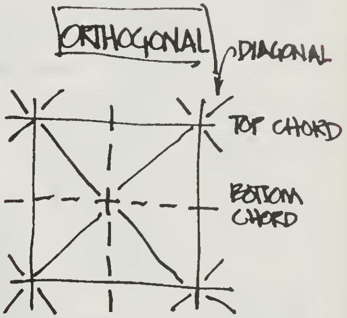
Another type of pre-engineered metal building system which might be applicable is modular arched steel panels. These steel panels are double curved and corrugated to form a self-supporting arch span or structure. Nut and bolt assembly provides for fast erection. This system is produced by Modular Technology - Wonder Building Division, Chicago, Illinois. Buildings are available in clear span widths from 8 feet to 300 feet.

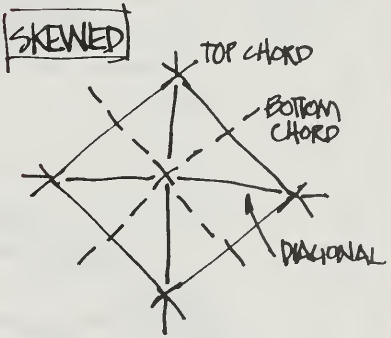
SPACE FRAME ELEMENTS

FIGURE IV-3

MODULE







MEMBERS CAN BE: WIDE FLANGES I
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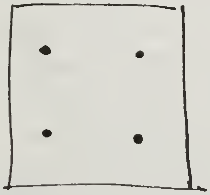
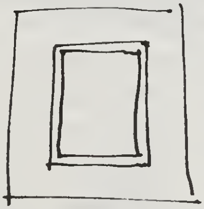
TEE ⊥

VERTICAL SUPPORT TYPES

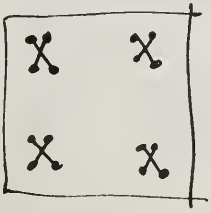
POINT SUPPORTS



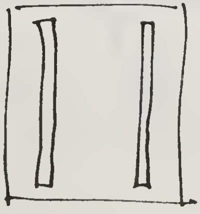
PERIMETER SUPPORT



CROSS-SUPPORTS



PARALLEL SUPPORTS



The geodesic dome, developed by R. Buckminster Fuller is an engineered system of triangular space frames. Maximum strength and space are inherent in the dome design. The triangular frames create a self-reinforcing roof and siding unit based on mathematically precise divisions of the sphere. This results in extra strength, because stress is distributed equally throughout structure of the building, and weight is transferred directly to the ground at angular points around the base of the dome.

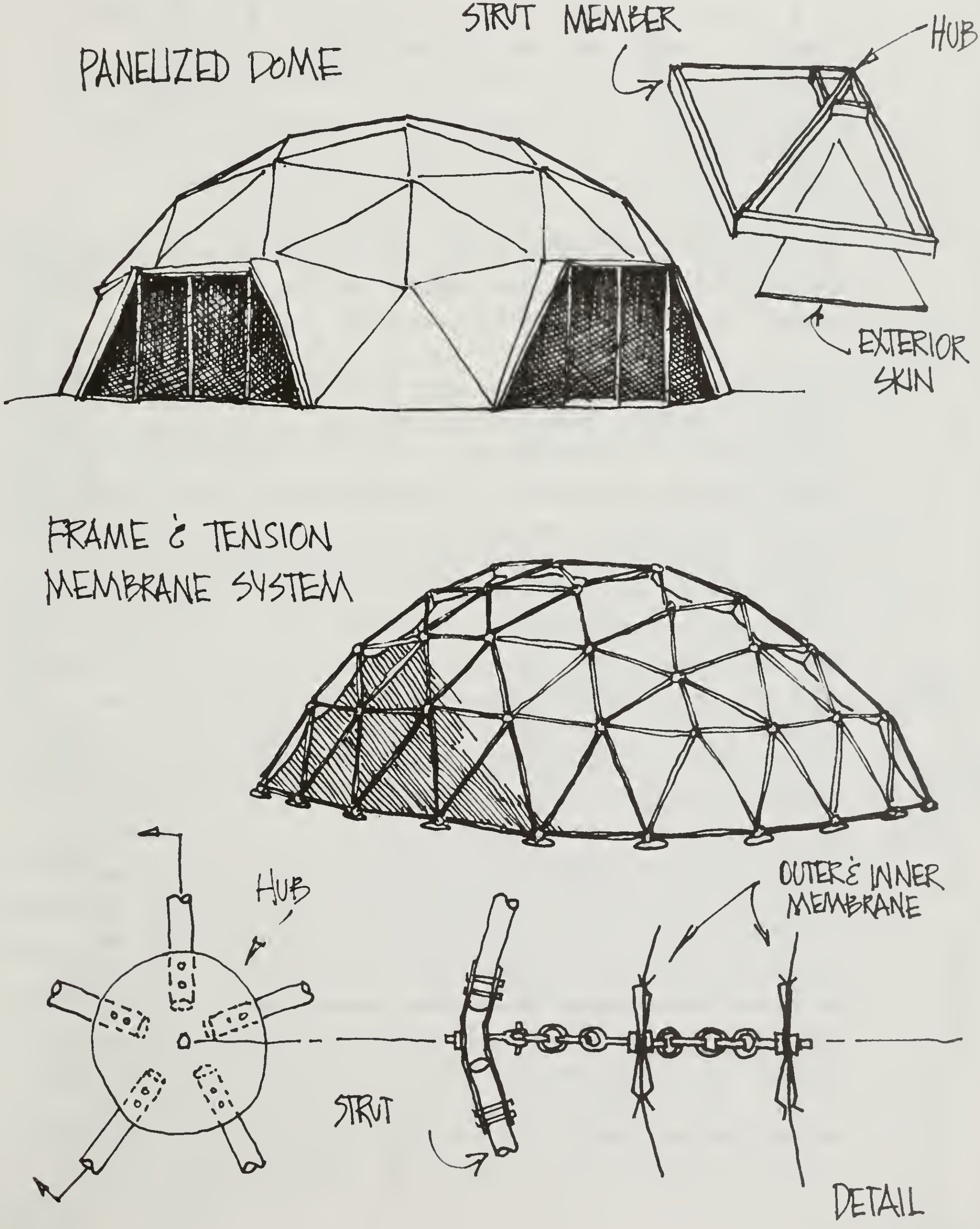
Domes have several characteristics advantageous to mobile/temporary situations. Pre-fabrication of components reduces on site labor costs. A foundation or support is only necessary at angular points around the base of the dome. Its light weight reduces the cost of footings and foundation which are not reuseable. No heavy equipment is necessary for erection and for small scale installations (50 ft. in diameter or less) unskilled labor can be used. It takes approximately 100 man hours to erect the dome skin after the foundation is poured. Transportation is relatively inexpensive due to its inherent light weight. A dome is versatile for relocation because it can withstand earthquakes and severe wind and snow loads.

Domes currently being manufactured can span from 24 feet to 250 feet. The make-up of the exterior skin also varies considerably such as sandwich panels and stressed skin panels of aluminum, wood, plastic, etc. The portability of a dome is greatly dependent upon connections between struts, hubs, and exterior membrane. If these elements are panelized, disassembly would be more difficult because the large number of joints will require extensive waterproofing. An economical method of reuseable joint covers is not produced so joints are very critical and parts are not easily disassembled. If the structure (struts and hubs) was separate from the membrane, the membrane could be in one piece such as a vinyl material. Disassembly would be simple; the vinyl could be taken down and rolled up, then the struts and hubs could be disassembled.

INDUSTRY SURVEY

GEODESIC DOMES

FIGURE IV-4



Questionaires were sent out to 100 mobile home manufacturers serving the Old West Region and 30 more questionaires were mailed to producers of air structures, domes, and pre-engineered metal buildings. (See Appendix for sample questionaire and manufacturers' addresses). Thirty companies responded and ten questionaires were returned unopened. The listing represents a cross sampling of the manufacturers involved in the production of specific types of construction discussed in this section.

The first page of the table indicates the industry character (product and services) of individual manufacturers and the second page is more detailed in the area of relocation and costs.

The location refers to the state where the main manufacturing plant is situated. Ownership defines whether the company is controlled by public shareholders or private individuals. Primary activity describes the type of structure manufactured, i.e., mobile homes, portable (construction similar to mobile home yet not necessarily for living, but for offices, classrooms, etc.), pre-engineered metal building, and other refers to either dome or air structure manufacturing. The services section describes what operation services are offered by the company from design to management (rental). The market area defines the general sales area of the company. Management structure is defined under management. Aquisition refers to how structure use is offered by the company, i.e., outright purchase, rental. The comment section usually details building types available. On the second page of the chart, structure type calls out the basic structural system of the building (other is either a post and beam, stressed metal skin, or air supported type structure) structural materials are next and other refers to either aluminum of plastic. The clear span section refers to the maximum structural span unobstructed with support elements. Fabrication calls out where component manufacturing occurs and production per day. The installation area defines who erects the structures such as the manufacturer's own crew or sub contractor, etc., and installation quantity per day. Cost is defined in terms of dollars per square foot. The general accepted transport range from the plant to job site and cost for truck load per mile is indicated under highway transport. The

SURVEY RESULTS

TABLE IV-1A

COLORADO(C), IDAHO(I), CALIFORNIA(CA), NEW YORK(NY), INDIANA(IN), SOUTH DAKOTA(SD), MICHIGAN(M), MISSISSIPPI(MI), TEXAS(T), OREGON(O), UTAH(U), WYOMING(W), KENTUCKY(K), OKLAHOMA(OK), WASHINGTON(WN).

	LOCATION	OWNERSHIP		PRIMARY ACTIVITY				SERVICES				MARKET AREA	MANAGEMENT			AQUISITION			CONTRACT			COMMENTS
		PUBLIC	PRIVATE	MOBILE HOME	PORTABLE	PRE-ENG.	OTHER	ARCH/ENG.	PRODUCTION	ERECTION	MANAGEMENT		OPEN	CLOSED	CONSORTIUM	PURCHASE	RENT	LEASE/PURCHASE	PERFORMANCE	TRADITIONAL	TURNKEY	
CENTRAL HOMES	C		X	X					X			ROCKY MTN.		X							X	
CENTURY HOUSING	C		X	X				X	X	X		NW & SW		X		X					X	
CHAMPION HOME	M	X		X					X			USA		X		X				X		M.H.S. & R.V.S.
CHICKASHA MOBILE HOME	OK	X		X					X			MID USA		X		X				X		
CONTINENTAL	C		X	X					X			ROCKY MTN.		X		X						
DETROITER MOBILE HOME	M		X	X					X			USA				X				X		
MOBILE OFFICE MANUFACTURING	U			X	X			X	X	X	X	USA	X			X		X	X	X	X	
MODULINE	WN	X		X					X			NW SW				X				X	X	
REX MOBILE HOME	O	X		X				X	X	X	X	NW		X		X			X			
SCHULT MOBILE HOME	IN	X		X				X	X	X		USA	X			X			X	X	X	
STYL HOMES	W		X	X				X	X	X		ROCKY MTN		X		X					X	MOD-ULARS
TAMARACK	I		X	X					X			NW	X			X				X		
ELDER·QUINN	C		X		X				X	X		ROCKY MTN		X		X	X	X			X	OFFICES CLASSRMS.
FORT LUPTON	C		X				X		X	X		ROCKY MTN.				X				X		MOD-ULARS
RUSHMORE	SD	X		X	X			X	X	X		GREAT PLAINS	X			X			X	X		
SKYLINE	I	X		X				X	X	X		USA				X				X		
DOME EAST	NY		X				X	X	X	X	X	USA				X		X		X	X	DOMES
GEODESIC	M		X				X	X	X	X		USA	X			X				X		DOMES
TEMCOR	CA		X				X	X	X	X		USA		X		X				X		DOMES
MITCHELL	MI	X				X			X	X		USA		X		X		X	X	X		METAL BLDG.
A & S STEEL	T	X				X		X	X	X		USA	X			X	X		X	X	X	METAL BLDG.
PASCOE STEEL	CA					X		X	X	X		SW				X		X	X		X	METAL BLDG.
IRVIN IND.	K	X					X	X	X	X		USA		X		X		X	X	X	X	AIR STRUCTURE
BIRDAIR	NY	X					X	X	X	X	X	USA		X		X		X	X	X	X	AIR STRUCTURE

relocation section deals with the ease of disassembly and if the manufacturer has been involved in relocation of its units.

TRANSPORTATION

Transportation can greatly inhibit the ease of installation and relocation of the community. The information contained in this sub-section pertains to how mobile homes and long span structures could be shipped from the manufacturer to the erection site.

Mobile homes will constitute the bulk of community elements to be transported. There are several modes of transportation available: highway, railroad, and air. Highway transport is the most common means. Railroad and air shipment has been limited due to the higher costs involved.

Trucking has emerged as the dominant method of shipping mobile homes because of economies in time and money. "Generally, the economical range of truck transport is 250 - 300 miles from the plant with a maximum range of 450 miles. Beyond that, it is impractical to ship by truck due to the restrictions of over-dimensional loads."[17]

A large problem with trucking is that each state controls the highways within its borders so highway regulations vary from state to state. The major problems in the Old West Region are the result of: lack of standardized travel times, signage and lighting requirements, escort and towing vehicle regulations, expeditious routing, etc. "Experience indicated that use of the high visibility, multi-laned, divided freeway was the optimum method for such routing."[18] The interstate system in the Old West Region is not very extensive so many transport miles will be logged on secondary roads. The result is: circuitous routing and implementation of more restrictions such as load widths and escort vehicle requirements. The cost of complying to the regulations is eventually passed to the consumer. "Transportation costs could be reduced as much as 40% if restrictions were simplified and/or standardized."[19]

SURVEY RESULTS

TABLE IV-IB

SOURCE: HNTB MANUFACTURER'S SURVEY

VARIES (V)

	STRUCTURE TYPE			STRUCTURE MATERIAL			CLEAR SPAN	FABRICATION				INSTALLATION					COST	HIGHWAY TRANSPORT		RELOCATION	
	MODULE/BOX	SPACE FRAME	OTHER	WOOD	STEEL	OTHER	FEET	OFF-SITE	ON-SITE	COMBINATION	QUANTITY/DAY	MANUFACTURER	SUB-CONTRACT	TECHNICAL	DEALER	QUANTITY/DAY	$/SQ.FT.	RANGE (100 MI)	COST ($/MI)	DISASSEMBLY (S) SIMPLE (C) COMPLEX	EXPERIENCE
CENTRAL HOMES	X			X	X		28		X		3										
CENTURY HOUSING	X			X	X					X		X	X		X		14-23	8			X
CHAMPION HOME	X			X	X	X									X		13			S	
CHICKASHA MOBILE HOME	X			X			16	X			4	X				4		10		S	
CONTINENTAL	X			X				X					X				17-19	10		S	X
DETROITER MOBILE HOME	X			X	X		14						X		X				1	S	X
MOBILE OFFICE MANUFACTURING	X			X	X			X				X	X	X			16		1.1	S	X
MODULINE	X			X				X			2				X			5	V	S	
REX MOBILE HOME	X			X	X					X			X		X				1.25	S	X
SCHULT MOBILE HOME	X			X			28			X	10	X	X		X	1	16-18	4	.7	S	
STYL HOME	X			X			14	X				X	X	X	X	4	18		4	S	X
TAMARACK	X			X	X			X			4	X						5	.73	S	X
ELDER·QUINN	X			X				X				X	X				13-20	10	1	S	X
FORT LUPTON	X			X				X	X	X	3							6			
RUSHMORE	X			X				X				X	X		X				.8	S	X
SKYLINE	X			X	X		14	X				X	X				13	1.5		S	X
DOME EAST		X		X			130	X				X		X							X
GEODESIC		X		X			60	X			3			X		1/3	5-6				X
TEMCOR			X			X	232	X			$\frac{1}{30}$	X		X			10-50			C	
MITCHELL			X		X		180	X				X	X	X	X		16			S	X
A & S STEEL			X		X		250	X	X				X	X	X					C	X
PASCOE STEEL			X		X		30	X	X	X		X						5		C	
IRVIN IND.			X			X	400	X			$\frac{2}{7}$	X	X	X	X	$\frac{2}{7}$	3-4			C	X
BIRDAIR			X			X	1400			X	V		X	X		V	3-6			S	X

Generally three types of highway transportation systems are available: common carrier, contract carrier, and private carrier. When a large quantity of mobile homes are to be shipped, the contract carrier offers several advantages: quick availability of personnel and equipment and a flexible work schedule. Common carriers would be more economical for small shipments because funds would be committed only as the need arose. There are several general rules the carrier should follow to reduce shipping costs:

- Obtain a multiple trip permit
- "Piggy-Back" empty transporters
- Consult with state officials to obtain most expeditious routes
- Provide and maintain portable electric harnesses
- Negotiate with authorities to reduce escort car requirements.[20]

"The mobile home frame and structure are susceptable to damage caused by significant road shock that may be induced into the structure by adverse highway or operating conditions . . . The subtle adverse effect of lesser shock and repeated vibration upon the mobile home frame and structure becomes particularly evident during 'secondary' transportation movements, reducing the home's useful life."[21] Semi-trailers are manufactured to reduce in transit shock and vibration. Pneumatic and hydraulic, enroute load levelers permit independent vertical adjustments of all sides of the carrier's load. Mobile homes are not outfitted with this type of trailer frame but it may be worth the extra shipping expense, especially when considerable travel is over poor road conditions. These load-leveling trailers also can be used to raise the unit for easier unloading.

Secondary movement of mobile homes is more critical than the initial shipment. The additional weight of the owner's household goods and personal effects may exceed the manufacturers' transport design load. H.U.D. has developed basic criteria for inspecting mobile homes before secondary transport to eliminate structural strain and unbalanced shipping:

- The frame should securely support the mobile home.
- Examine structural soundness of the mobile home (wall, roof, floor, etc.)

- o The furnishings and goods inside the unit should not exceed manufacturers design loads (3 lbs/sq. ft).
- o Check running gear, lights and coupling mechanism to assure adequate operation.

The average cost of shipping a mobile home is one dollar per mile. Additional costs are incurred with oversized loads (12-1/2 feet plus in width and over 70 feet in length) such as an additional escort vehicles ($.35/mile) and oversize load permits ($5.00 to $25.00 per state). Professional carriers generally charge 30 per cent or more for secondary moves than primary moves.

"Within the shipping radius of the typical American modular producer's marketing area, the economics of rail shipment formerly precluded the use of this means of transportation. Ordinarily, unless a sizeable market can be established at some distance from the manufacturing plant, no competitive advantage over truck shipment can be anticipated."[22]

However, "handled properly, rail shipping in certain situations can clearly overcome distance/cost barriers. 'Breakthrough' experience indicates that it's use required the skills of a full-time, experienced transportation manager who possesses authority to control the entire operation. Rail shipping is unique and quite complex, and many past failures with this mode of transportation can be attributed to the absence of such skills or the lack of adequate authority."[23]

The optimum situation for the use of rail transport would be loading the mobile homes right from the plant on to railroad cars, shipping them in large quantities (unit train) to a site adjacent to a rail spur, and unloading and siting in one operation. Generally though, in the Old West Region, railroad lines are sparse so mobile homes would probably have to be unloaded from a spur to trucks, trucked to the final site and unloaded. Like anything else the more operations necessary, the more potential for error, and more time and money are expended.

Sources of rail shipment costs are: flatcar rental ($5.00/day), trucking to and from railhead ($1.00/mile), crane for unloading and loading

($40.00/hour), securing units (1.5 hours/unit @ $10.00/hour), switching ($30.00/switch/car), spur track rental (varies), and railroad shipment rates (varies). Section 22 of the Interstate Commerce Act allows the carrier authority to reduce shipping rates for government (federal, state, and local) sponsored housing by at least 30%.

The use of air-cargo transportation in its present form, for the shipment of modular housing units cannot be justified.[24] The economics of air transport is the main prohibitive factor.

The shipment of long span structures such as pre-engineered metal buildings and air structures is usually done by truck. Though railroad shipment can be utilized in most situations trucking is less expensive. For example the components of a pre-engineered metal building of 10,000 sq. ft. can be hauled on one semi-truck for about one dollar/mile.

Tractor-trailers are more versatile as to their movement. Trucks can generally be pulled in immediately adjacent to construction sites. Unloading and erection can proceed as one operation. For example, once the air supply equipment and side walls of an air structure are erected the membrane can be unrolled and inflated as the carrier drives the length of the building's floor. The mobility of a truck also makes on-site loading and unloading of utility distribution components generally less expensive than other contemporary methods.

LYMAN/COLSTRIP

To point out what communities have done in the not to distant past to adapt to impact growth, the towns of Lyman, Wyoming, and Colstrip, Montana, will be discussed. Lyman was an existing small, rural community whose population quadrupled in a few years. Colstrip was an existing small, rural community also, but the degree of development implemented by the owner is so great that it can be considered a "new town". These two towns will be compared on the basic elements of a community, i.e.

infrastructure, community services, commercial facilities, etc.

It is important to reflect on the background of these two communities. The community of Colstrip grew out of the coal mining operations in the area during the early 1920's. The town was owned and operated by Northern Pacific Railway until diesel oil became a better locomotive engine fuel. The Montana Power Company purchased Colstrip and mineral rights for the surrounding area in 1959. Colstrip was essentially a ghost town until 1968 when coal mining started up again (population 250). The population was around 600 until construction of two coal fired electric generating plants (330 MW each) began in 1973. The peak construction force reached 1450 in 1975. Power unit one was completed at the end of 1975 and unit two will be finished in the summer of 1976. The population will probably stabilize below 2500 before construction of power units three and four (750 MW each) are built. By 1981 the population of Colstrip will exceed 5000.

Lyman developed into a trade center serving the Bridger Valley in the early 1900's. The town contained such amenities as a flour mill, newspaper, photo gallery and theatre. In 1919 an electric plant was constructed and gradually expanded its services to the entire valley by 1940. Population of the town gradually increased until the early 1960's. After the construction of Interstate 80 and the Meeks Cabin Dam, population dropped but was revived as a residential community for employees of the local trona mining operations. The 1970 census established Lyman's population at 643. Due to the expansion of soda ash processing plants in Sweetwater County, Lyman's population had grown to 3000 but stabilized at 2000 by 1975. By 1980 the community will have to accommodate approximately 2500 people. This represents a growth rate of almost 400% within 10 years.

HOUSING

In 1970 the number of dwelling units in Lyman was 189. (Single family, mobile home, and multi-family). By 1974 the amount of dwelling units had increased to 398 (146-single family, 220 mobile homes, and 32 multi-family). This figure does not include Trona Village (211 mobile home spaces and 176 recreation vehicle spaces), which was later annexed to the town. At the time of peak impact 360 spaces in Trona Village were occupied.

Trona Village was the project of the Food and Machinery Corporation, a major contributor to impact growth in Lyman. FMC invested over 1.5 million dollars into the mobile home park. The 60 acre site before annexation was adjacent to the city boundary. The development occurred outside the city due to limited water and sewerage facilities. The mobile home lots are 40 ft. x 60 ft. and were laid out to be combined to form residential lots (80 x 60) after temporary residents have left.

In 1972 the residential sector of Colstrip consisted of 38 multi-family dwellings, 64 single family dwellings and 128 mobile homes. "The Western Energy Company decided to completely develop the community from housing to recreation because from the standpoint of economics, public relations, and employee relations, the benefits were worth a substantial investment."[25] The existing housing facilities were increased by:

- 170 houses (800 to 1300 Sq. Ft.)
- 44 apartments (2 & 3 bedrooms with garage)
- 24 apartments (700 Sq. Ft./1 bedroom)
- remodeled dormitory (310 beds with mess hall)
- 150 permanent mobile home spaces
- 450 temporary mobile home spaces
- 150 camper spaces with trailer bath houses (located with temporary mobile home spaces near plant construction site)

INFRASTRUCTURE

Obviously with such an increase in housing capacity the infrastructure of Colstrip had to be beefed-up. Additional water was supplied by adding another well to the existing water system (four wells @ 85 G.P.M. with storage tankage of 285,000 gal.) and by tapping off of the water line originating from the Yellowstone River used to cool the generating plants. Both P.V.C. and cast iron piping were used. With the help of a loan from the Environmental Protection Agency an oxidation lagoon system was constructed to treat sewage. The sewage flows via gravity through cast iron, P.V.C., and vitrified clay piping to the treatment facility. Water treatment of previous and current water supplies is accomplished through chlorination. The power sources in Colstrip are propane gas and electricity.

Lyman also had to invest in utility facilities. Seventy thousand ($70,000) dollars was spent to expand the city's water system by adding another well and running a 6" main line to Trona Village. The main is cast iron pipe and laterals and service lines are P.V.C. The water is treated with chlorine. Eighty thousand ($80,000) dollars was invested in a 2 cell oxidation lagoon sewage treatment plant. The sewage collection system is made up of P.V.C. and transite piping. Regarding Trona Village; electricity and water was supplied to each recreation vehicle space and natural gas, electricity, water, and sewage hook-ups are located at each mobile home lot. The gas, electric, and telephone lines were installed underground by the utility companies. Solid waste is disposed of in a dump.

COMMERCIAL FABRIC

No new commercial facilities have resulted from impact growth in Lyman. The current commercial sector (all permanent type construction) consists of:

- Grocery store (6400 Sq. Ft.)
- Department/Grocery Store (9600 Sq. Ft.)
- Implement/Hardware Store (3600 Sq. Ft.)
- Drug Store with no Pharmacy (800 Sq. Ft.)
- Laundromat/Dry Cleaner (16 Washers & 6 Dryers)
- Beauty Shop
- Barber Shop

- 2 Service Stations
- Motel (35 Rooms)
- Cafe/Bar (8800 Sq. Ft.)
- Drive-In/Fast Food
- Movie Theatre (200 Seats)[26]

Colstrip's commercial facilities (all permanent type construction was used unless specified otherwise) have come into being recently and others are anticipated. The new 26,000 Sq. Ft. commercial center is presently 60% rented and contains:

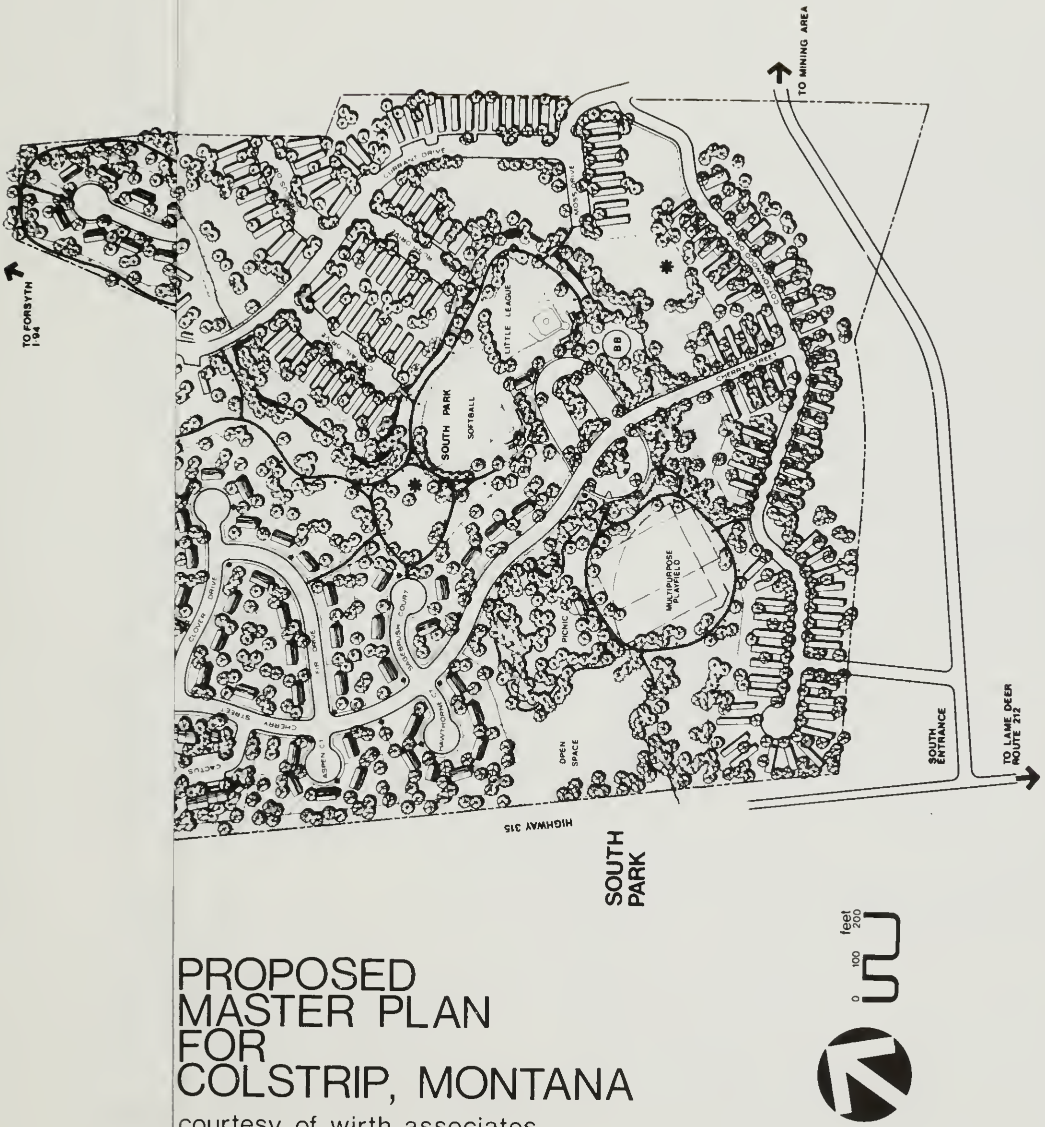
- Hardware/Drug Store
- Arts & Crafts Shop
- Insurance Office
- Laundromat
- Barber Shop
- Post Office
- Clinic
- Restaurant (Anticipated Occupant)
- Clothing Store (Anticipated Occupant)

Other commercial buildings outside the center are:

- Motel (20 rooms)
- Bank (2400 Sq. Ft.)
- Grocery Store (under construction - 15,000 Sq. Ft.)
- Service Station (anticipated)
- Pizza Parlor (3000 Sq. Ft.)
- Bar/Restaurant (2 miles from town)
- Lunch Room at construction site (converted trailer).[27]

COMMUNITY SERVICE

Within this sub-section recreation, health care, cultural facilities, police, and fire protection will be compared. Education has been



PROPOSED MASTER PLAN FOR COLSTRIP, MONTANA

courtesy of wirth associates

- 2 Service Stations
- Motel (35 Rooms)
- Cafe/Bar (8800 Sq. Ft.)
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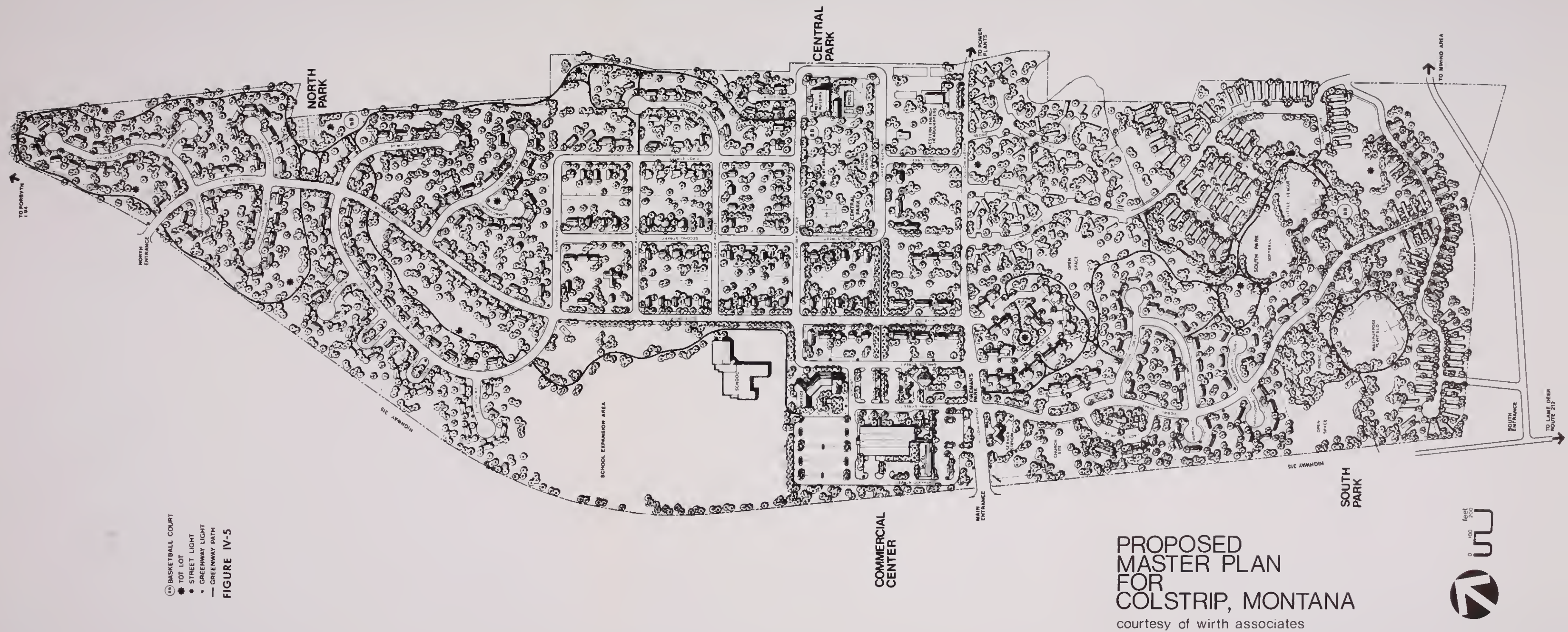

FIGURE IV-5

PROPOSED
MASTER PLAN
FOR
COLSTRIP, MONTANA

courtesy of wirth associates

included in a sub-section separately due to the importance of structure types used.

The recreational facilities in Lyman and Colstrip are diverse. The main reason for such a difference is that Colstrip was a totally planned community with recreation as a critical design objective. Recreational space utilizes about 7 acres in Colstrip, whereas Lyman has allocated about 20 acres. Colstrip's recreational program consists of: baseball fields (3), tennis courts (6), ice skating rink, competition size swimming pool, community center (15,000 Sq. Ft. permanent structure includes gym, handball courts, meeting rooms, etc.) and a community recreation director. Lyman's facilities consist of: town park with picnic tables, school playground which has been greatly reduced due to additional school buildings, camping area, and combination rodeo grounds and playfield.

Colstrip's health care is also more expanded than Lyman's. A clinic is located in the commercial center (1100 Sq. Ft.) which is staffed by a full time nurse, assistant, and a general practitioner who comes in once a week. This clinic is supplemented by a field clinic with a full time nurse located near the construction site. Two ambulances are also in the community to transport patients to Forsyth Hospital (35 miles away). Lyman does have a clinic building (permanent type construction) but it is not being used. A dentist does have a practice in town but there are no medical doctors or nurses. The nearest hospital is in Evanston (40 miles away).

Cultural facilities in both communities are rather limited. Lyman does have a small public library (permanent structure). In Colstrip an existing two story house has just been remodeled to service as a library and arts and crafts shop. The library services are supplemented by a bookmobile originating from Billings.

Police protection in Lyman is provided by the city police force which has expanded to three field officers. Rosebud County Sheriffs Department is responsibile for law enforcement in Colstrip.

Both towns have volunteer fire departments. Equipment is similar also; one pumper truck with pick-up trucks for back-up units.

SCHOOL SYSTEM

Lyman's total school enrollment in 1970 was 360 students. Today, attendance is over 600. Much of the development of new facilities was spurred by industry. Allied Chemical donated three modular buildings (6 classrooms). FMC Corporation constructed a pre-engineered metal building (10,000 Sq. Ft. with 8 classrooms). The people of Lyman also passed a $240,000 bond issue which implemented the construction of two more metal buildings. Including the old high school the school system's spaces include: 30 classrooms, 7 offices, a shop, 6 laboratories, a gymnasium, a multi-purpose room, a cafeteria, a library and a swimming pool. The school system employs 38 teachers and 4 administrative personnel. With the allocation of $850,000 from the Wyoming State Farm Loan Board planned new facilities include: 16 classrooms, a gymnasium, library, special-ed rooms, and offices.

Before substantial impact growth occurred Colstrip's school enrollment was about 250 pupils. During the '75-'76 school year the student population reached over 800. Before 1973 the school areas included 14 classrooms, cafeteria, and gymnasium. In 1973 Western Energy added four relocatable units (27 ft. x 27 ft. - wood construction with flat roof) at a cost of $20,000 each. In 1974 plant carpenters, plumbers, and electricians assembled nine mobile classrooms (900 sq. ft.). The units are lined up with long sides parallel with a common hallway in between. The units were designed to disassemble from each other and to be used for houses once permanent facilities have been erected. In 1975 3500 sq. ft. of the commercial center were used as classrooms. Two bond issues have been passed and the three million dollars will be used for remodeling the old school building and constructing a new elementary school.

SECTION SUMMARY

The "state of the art" regarding temporary/mobile facilities is not the most promising although some elements appear to have more potential than others. A major breakdown is in the water and sewage systems. Until the Alaskan pipeline, no water or sewage collection/distribution system was manufactured or designed for portability. These new portable piping systems only solve part of the problem. For application as main lines these systems have proven feasible, but service lines will have to be installed via conventional methods until further development occurs. Treatment systems for both water and sewage on the other hand are manufactured components and are designed with portability as an important criteria. The architectural types discussed offer the most potential for relocation yet mobile homes and air structures appear most feasible. Mobile homes are just that; mobile. They are set up for highway transport, require no permanent foundation, and are mass produced for lower costs. Air structures are essentially large tents, but the support system is a pressurized space. Essentially once you have removed the enclosing membrane and HVA/C system the building is moved. The cost of air structures is also attractive. A few lessons are to be learned from Colstrip and Lyman. One is that planning is an important aspect in the development of any community. The reuse of mobile home spaces for later residential construction is one way to pay for infrastructure investments. The reuse of temporary facilities (i.e. Colstrip - classrooms to houses) is another method worthy of consideration.

FOOTNOTES

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9. Ibid, pg. 4
10. Ibid, pg. 184
11. Ibid, pg. 261
12. Ibid, pg. 422
13. Ibid, pg. 40
14. DeCamp, L. Sprague, The Ancient Engineers, (Doubleday & Co., Inc., Garden City, New York, 1962) pg. 556
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27. Murphy, Jim

DESIGN CRITERIA

INTRODUCTION
SITE PLANNING
NEIGHBORHOOD
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RECREATION
ARCHITECTURE
ARCHITECTURAL ENVIRONMENT
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UTILITY NETWORK
WATER SYSTEM
SEWERAGE SYSTEM
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POWER
PORTABLE PIPING
MOBILE HOME STAND
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DISPOSAL TECHNIQUES
ROADWAYS
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INTRODUCTION

A community should meet all the needs of its inhabitants. Specific needs should be met for the workers, their wives, young children, and teenagers. Major considerations for women and children will help balance the seemingly all male oriented community inherent within construction sites. A more complete environment will tend to reduce both domestic strife and work force turnover.

Design criteria is the basis of establishing a decision making program. Goals or concepts are stated and limitations are set. Town planning, architectural, and engineering design considerations will be discussed in this section.

Before discussing particular elements of a community the respective size or population has to be determined. The construction worker influx set by the Old West Regional Commission as our basic design criteria was 500, 1000, and 1500 workers. The corresponding community sizes would then be 1500, 3000, and 6000 people based upon a Population/Worker ratio of 3.0.*

Town planning is broken down into several discussions: Site Planning, Neighborhood Concept, Recreation and Residential Layout.

SITE PLANNING

Even though some communities may be in existance at one location for less than three years, site planning is critical. Several factors influence site selection: proximity to construction site, topography, soil conditions, views, vegetation, climate and microclimate, etc. "It is important to separate unrelated activities as much as possible so that they do not interfere with each other accidentally."[1]

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*These figures are approximate and meant for general illustration. The actual Population/Worker ratio will vary depending on the construction project and its proximity to existing communities.

The temporary community site should be located reasonably close to the construction area to limit transportation time and to cut length of supply lines if water and power sources originate there. Yet the senses should be buffered from the visual appearance, objectionable odors, and noise surrounding a construction site. Topography, climate, and vegetation can be used to isolate the community from undesirable elements. See Figure V-1.

Topography has to be considered to limit destructive and costly excavation or fill, to avoid drainage problems, to permit operation of gravity flow utilities, to enhance views, etc.

Soil bearing conditions should be studied to avoid unnecessary movement of buildings and roadways. To insure a healthy human environment free of insect breeding grounds, rodents, etc., terrain restraints must be considered.

A site surrounded by pleasant vistas can enhance the environment's visual attributes, and establish a sense of place. Desirable views will obviously increase the quality of life of an area.

Since most of the developments may not be in one location long enough to allow for newly planted vegetation to mature, natural vegetation must be respected and incorporated within the community plan as much as possible. Vegetation accomplishes several ends: prevents erosion and limits dust, creates a human scale, acts as a buffer of vision, wind, and sunlight and provides variety in color, acoustics, texture, and olfactory stimulation.

The direction of summer and winter prevailing winds, local winds, and sun orientation should influence the design of a community. Building heat gain or heat loss can be easily controlled by efficient building orientation. For example: a structure with windows facing south will be exposed to intense sunlight in the winter while in the summer greater heat gain will result from a western orientation even with large roof overhangs (due to the higher daytime position of the sun) yet north light never permits solar heat gain, therefore; buildings with north window exposures will be cool in summer but more expensive to heat in winter. South light when controlled with overhangs to protect against summer sun is economically most desirable, and the west facade should be well insulated and without windows to limit heat gain in the summer.

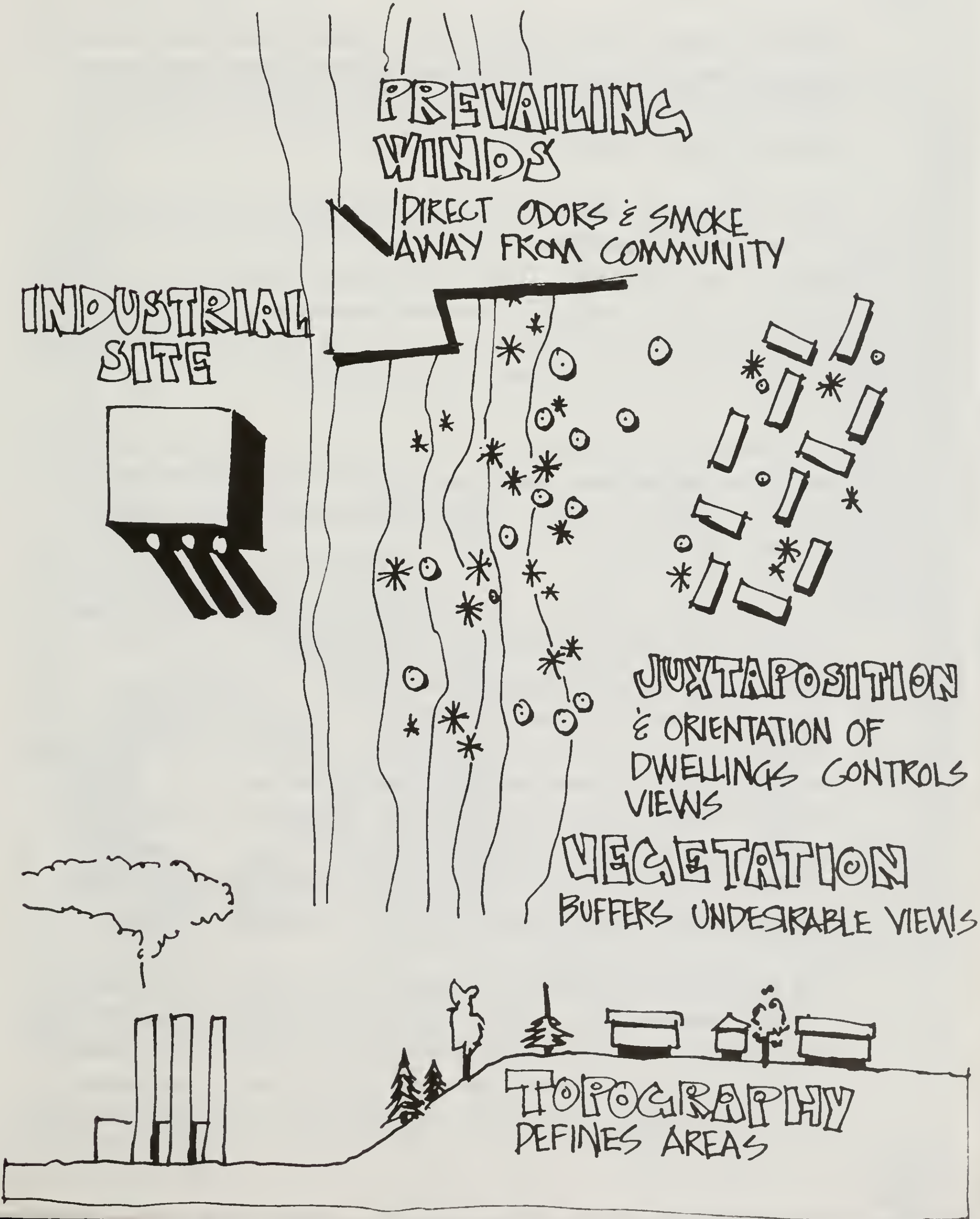
NEIGHBORHOOD

"The size of the neighborhood should be confined to pedestrian distances, for the human stride ought to define the scope of the local living space. All points of activity and interest should be within 10 to 15 minutes walking distance at most. To be well balanced in itself, the basic unit requires working places for its inhabitants in separate business and industrial segments as well as its own local administration, a shopping center, and facilities for education, recreation, and worship. A mere conglomeration of people doesn't create an organic community. However, provided with communal facilities, every part of the unit being well related in size and location, the inhabitants would have a good chance to improve social contact. Delinquency and crime will also decrease with the improved social character of the neighborhood unit; for it has been found that social ills result from the lack of coherence and effectiveness of the social group rather than from biological or psychological factors or even from poverty. Thus a neighborhood unit, through forethought and the proper planning of well integrated surroundings has a good chance to build up its own identity and to retain and strengthen it."[2]

The neighborhood concept is very applicable to the design of a temporary community on points other than Gropius's discussion above. A concentration of facilities not only brings human scale to the community but from

SITE PLANNING CONSIDERATIONS

FIGURE V-1


PREVAILING WINDS
DIRECT ODORS & SMOKE AWAY FROM COMMUNITY
INDUSTRIAL SITE
JUXTAPOSITION & ORIENTATION OF DWELLINGS CONTROLS VIEWS
VEGETATION BUFFERS UNDESIRABLE VIEWS
TOPOGRAPHY DEFINES AREAS

an engineering standpoint, it reduces the length of service lines (water, power, and sewer). The natural adjacency of structures adds a new dimension to the time-sharing concept. (See time-sharing sub-section).

Exterior elements such as parking lots, lighting, walks, etc., can be utilized more efficiently. Human concentration is proportionate to social interaction and interaction will help remove the temporary character of the community.

Neutra defines the Common Green of the neighborhood as "A central face to face area for recreation, green, clear of disconcerting and dangerous commotion, with elementary school, neighborhood assembly and play space, a public health service unit, a branch library, and a few scattered day nurseries for young children are all to be accessible over pleasant promenade walks and do not cross lanes of traffic."[3]

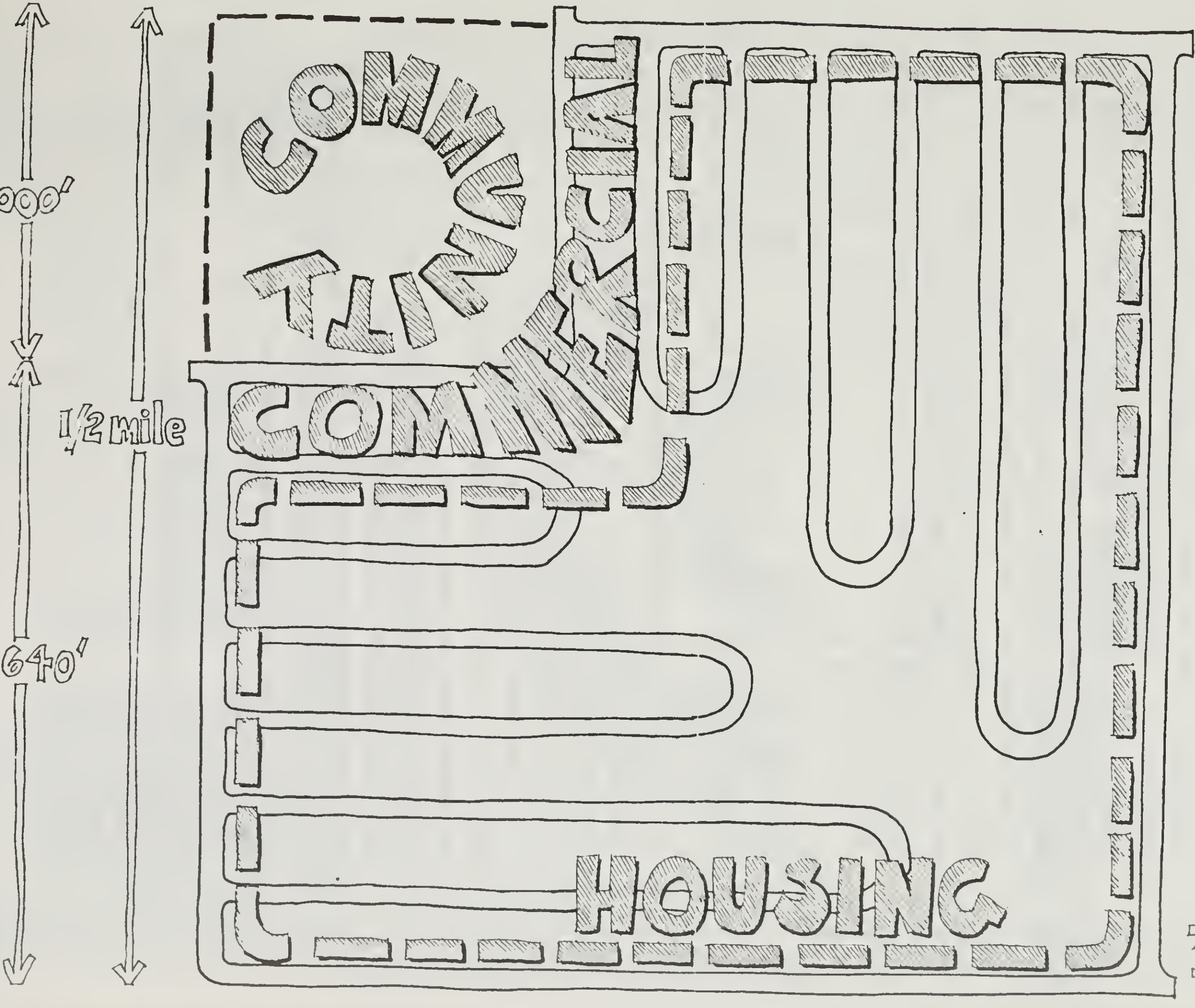
The Common Green which Neutra describes plus the appropriate commercial facilities and perimeter housing defining the communal area, could support a population of 1500. Idealy such a community would require at least 150 acre site. See Figure V-2.

A neighborhood of 1500 people is the basic unit in our village plan. Populations of 3000 and 6000 (1000 and 2000 construction workers) are broken into 2 and 4 neighborhoods respectively. "A settlement of this size (2+ neighborhood's) would allow close to home education up to the high school level, could provide most daily needs for goods and services and could begin important advances in health and social care."[4] The community should grow naturally with each neighborhood independent of the other yet dependent upon the community as a whole. A maximum of facilities should be provided for the initial neighborhood but duplication of community wide services should be avoided upon further growth.

Our village plan was developed to permit phased growth. See Figure V-3. The plan developed into a series of concentric greenbelts radiating from the village center and dividing the residential area. Major greenways, rotated 45° to the perimeter, lead pedestrians to the village center. The village center's "ideal shape would seem to be an oblong, from 1/2

FIGURE V-2

SCHEMATIC
OF
NEIGHBORHOOD
FOR
1500 PEOPLE



Scale
1'-0" = 250'

mile to one mile in maximum length, so that people need walk no more than a distance of up to 1/2 mile inside it to reach their schools, shopping areas, small parks and cultural and social centers . . . design allowing cars to enter any part of the sector and serve it but without actively crossing it. Thus the heart of the sector will be exclusively for pedestrians."[5] This ideal concept is not economical for a temporary community because circulation would have to be controlled vertically and excavation and bridges necessary to achieve this separation are not mobile elements. Yet Neutra's ideas should be considered and implemented as much as possible. The square plan keeps walking time from 10 to 20 minutes from anywhere in the village to the village center. The village center will be the hub of community activities. Community roads circulate around the village center to maintain a pedestrian environment. See Figure V-4.

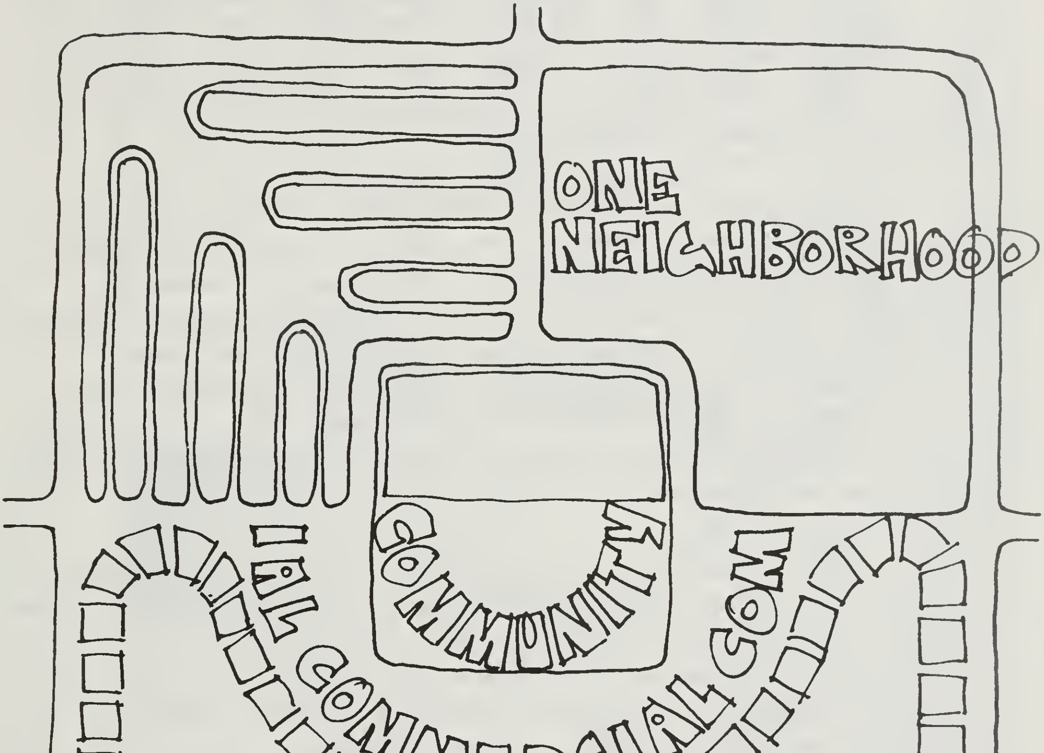
RESIDENTIAL AREAS

The layout of dwelling units or mobile homes in residential areas is important. Layout can effect many things such as residential security, infrastructure (utility distribution) cost, and social interaction. "Defensible space is a term used to describe a series of physical design characteristics that maximize resident control of behavior - particularly crime within a residential community. A residential environment designed under defensible space guidelines clearly defines all areas as either public, semi-private, or private . . . A series of small scale physical design techniques can be used to create defensible space and consequently to reduce crime in existing residential area. These techniques consist of subdividing a project to limit access and improve neighbor recognition symbolically defining an area as coming under the sphere of influence of a particular group of inhabitants."[6]

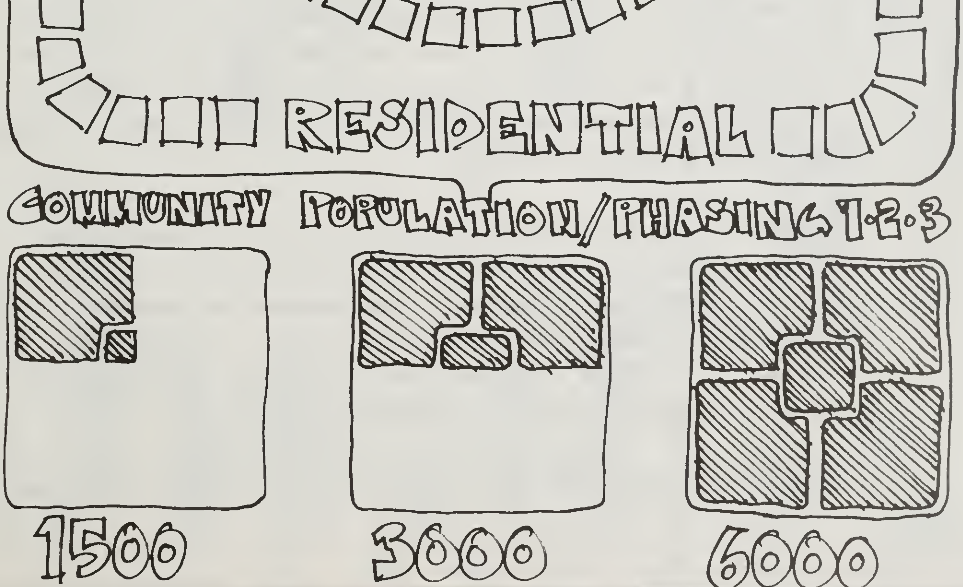
Figure V-5 will serve to illustrate defensible space. Zones can be defined by 2 or 3 "sides" or by proximity to other elements. The elements used to define a "side" can be tree, a berm, an automobile, etc., and not necessarily a vertical plane. Vertical (sides of a

VILLAGE PLAN

FIGURE V-3



COMMUNITY POPULATION/PHASING 1·2·3



building, fence, etc.) tend to be stronger physical barriers yet space can be defined without such structured elements. "Mobile homes might be grouped in clusters or attached in rows or lines with landscaping used for private enclosures and even the car might be sited to create space instead of destroying it."[7]

Once a zone or space is recognized its status (private, semi-private, or public) will be established in the minds of individuals depending upon proximity to people and scale. The status will indicate who extends his influence over the zone. A private zone would be controlled by a homeowner. Semi-private areas will be controlled by several homeowners and their families, and public spaces lack indentification and receive little attention. "Hopefully public areas will be adjacent to dwellings and allow residents to assume a further realm of territory and further responsibility.[8]

Community layout and structure orientation will affect social interaction. "The approaches and entrances to dwelling spaces are an example of transitional spaces that form the occupant's links with society. These approaches and entrances can be planned to act as subtle intersocial stimulants facilitating natural encounters with one's neighbors and even encouraging pauses for leisurely conversation."[9] Circulation patterns influences human interaction. Nodal points establish a sense of place along a path and encourage social interaction. The community design should be sensitive to humans and allow for human interaction in appropriate areas at a variety of scales from intimate to communal. "The physical health of each individual depends upon a beneficial interaction with other human beings."[10]

The layout of dwelling units can affect other human perceptions and spatial relationships. Spatial definition, order, and balance should exist in a harmonious environment. Even the sense of impermanence of a mobile home can be decreased through unit layout. "He (community designer) may also use landscape elements to express the permanence of the earth to which the units are momentarily attached."[11]

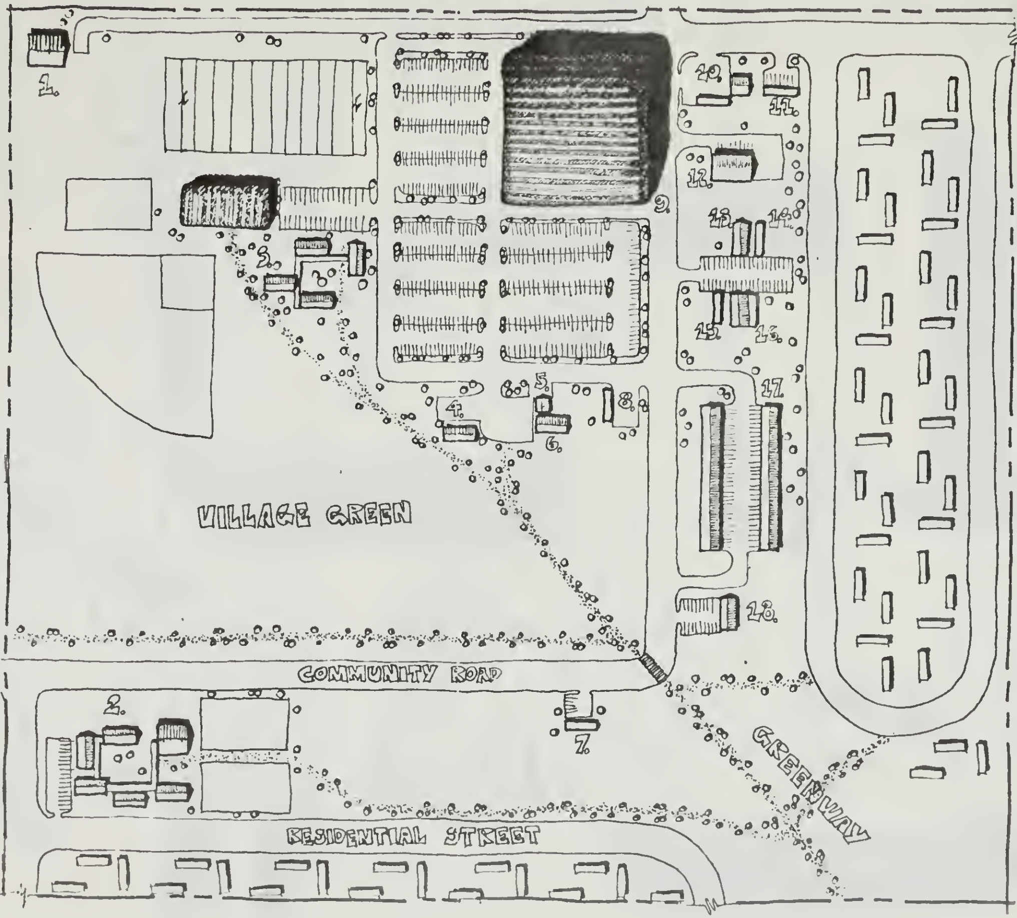
The space requirements of mobile homes vary yet residential areas should

VILLAGE CENTER

BASED UPON A COMMUNITY OF 1500 PEOPLE

FIGURE V-4

1 MAINTENANCE/TREATMENT
2 ELEMENTARY SCHOOL
3 SECONDARY SCHOOL
4 POST OFFICE
5 FIREHOUSE
6 POLICE/ADMINISTRATION
7 DAY CARE
8 MEDICAL CLINIC
9 SHOPPING MALL



10 GAS STATION
11 LAUNDRY
12 BUILDING SUPPLY
13 BAR
14 BARBER/BEAUTY
15 BANK
16 RESTAURANT/LOUNGE
17 MOTEL/APARTMENT
18 FAST FOOD

have a "... Maximum density of 10 units/acre but 7 units/acre is better."[12] Mobile home lots should have a minimum of 4500 square feet to accommodate double wides. An acre contains 43,560 square feet and 7 lots would need 31,500 square feet, the remaining area will be used for circulation and recreation. F.H.A. recommends a minimum of 150 square feet/unit for recreation.

RECREATION

"Play is apparently essential for learning, socialization and defense."[13]

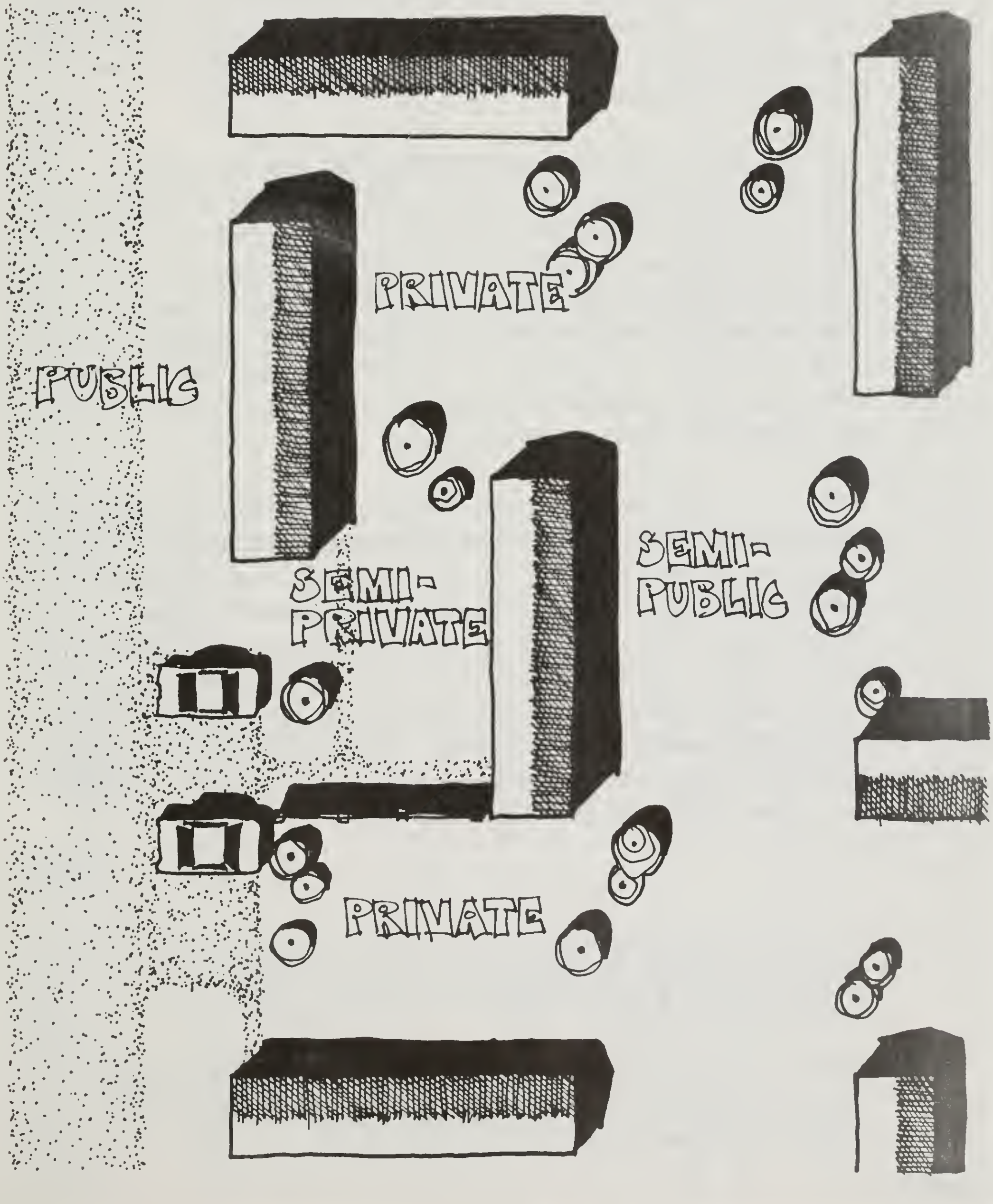
Due to the climate in the Old West Region, a strong emphasis must be placed on indoor recreation. Outdoor recreation facilities should provide a large variety of activities. Club and organizations should be established to reinforce recreational participation and sense of community. Any "advertisement" of a certain activity or facility will attract more attention and use. Clubs and organizations anywhere from Little League to a Bridge Club will promote interest; thereby increasing social interaction. Such interaction will tend to bind the community together.

Indoor spaces should be structured and proportioned to accommodate various recreational activity. A large free span space should be erected to provide an area for field type sports such as basketball, archery, volleyball, etc. This space could be used according to the time-sharing approach such as a school gymnasium. Smaller more intimate spaces should be built to house less strenuous recreation such as card playing, ping pong, etc.

The lands of the Old West Region are not densely populated and many acres are owned by State and Federal Governments. This opens up much land for many outdoor activities such as camping, hunting/fishing, boating, etc. The support community should provide facilities for more structured play such as baseball, tennis, horseshoes, etc., as well as facilities for passive play such as picnicing and walking.

PUBLIC / PRIVATE ZONES

FIGURE V-5



Outdoor recreation should be an integral part of any community design. "A complete recreation area shall include: a pre-school section (Tot-Lot), apparatus area for older children, open space (informal play), court surface, field for games, quiet area, shelter with toilet, wading pool, and game area for adults."[14] The recreation chart (Table V-1) defines the needed recreational facilities based upon the three community sizes (1,500, 3,000 and 6,000).

The location of children's play areas will vary with age groups. "Children one to five years in age are most comfortable in outdoor areas immediately adjacent to their dwelling . . . A play facility for the five to twelve year olds which is large enough to accommodate more active play (minimum size 2,500 sq. ft.) and sufficiently separated from the dwelling units to reduce noise penetration. The large play area is, however, still very much in view of every dwelling. . . Teen play areas should be bordered on three or four sides by the dwellings of residents to permit surveillance."[15]

Areas for informal and passive play can be located along the greenbelts and greenways (pedestrian areas) of the neighborhoods while structured play areas can be situated in the village center. A multi-use green would be more efficient for such activities as baseball, football, soccer, etc. A one acre green would be sufficient for one neighborhood (1,500 people). Basketball goals could be placed adjacent to tennis courts to permit double use of the hard surface. Lighting could also be installed depending on utilization. We recommend siting playfields (multi-use greens) and hard surface areas in close proximity to schools to further utilize the time-sharing approach.

ARCHITECTURE

"What is really different in our age, then, is the tempo of change, which has already been expressed in population and in social and economic phenomena but not in Architecture."[16]

OUTDOOR RECREATION CRITERIA

SOURCE; NATIONAL RECREATION AND PARK ASSOCIATION

TABLE V-1

RECREATION TYPE	COMMUNITY POPULATION 1500	3000	6000	COMMENTS
TENNIS COURTS	1	1	3	COURT SURFACE COULD ALSO BE USED FOR BASKETBALL, HANDBALL, VOLLEYBALL, ETC.
BASEBALL DIAMOND			1	A COMMON PLAYFIELD COULD BE USED FOR BASEBALL, FOOTBALL, SOCCER, ETC.
SOFTBALL DIAMOND		1	2	SOFTBALL DIAMOND RADIUS IS 200 FT AS OPPOSED TO BASEBALL WHICH IS 300 FT.
SWIMMING POOL	900 SQ. FT.	1800 SQ. FT.	3600 SQ. FT.	IT WOULD BE DIFFICULT TO INCORPORATE A POOL INTO A TEMPORARY COMMUNITY
SPRAY POOL			1	SPRAY POOLS COULD BE PORTABLE
SHELTER BUILDINGS	1	2	4	SHOULD BE LOCATED ALONG COMMON GREENS TO HELP DEFINE PICNIC AREAS.
PICNIC AREA	2.6 ACRES	5.2 ACRES	10.4 ACRES	CAN BE LOCATED ALONG COMMON GREENS
VOLLEYBALL COURT			1	CAN BE LOCATED ON TENNIS COURT SURFACE
HORSESHOE COURT	1	2	4	HORSESHOES IS AN ADULT GAME AND SHOULD BE LOCATED NEAR PICNIC AREAS
BASKETBALL GOALS	1	2	4	CAN BE LOCATED ADJACENT TO THE TENNIS COURT
TOTLOT (PRE-SCHOOL)	.75 ACRES	1.5 ACRES	3.0 ACRES	MAXIMUM SIZE OF A TOTLOT IS 4000 SQ. FT.
YOUTH PLAY AREA	2.25 ACRES	4.5 ACRES	9.0 ACRES	CAN BE LOCATED NEAR DAY CARE FACILITY & IN GREENWAYS
CHILD/ADULT FIELD	2.25 ACRES	4.5 ACRES	9.0 ACRES	CAN BE LOCATED NEAR SCHOOLS

Most contemporary methods of construction deal with permanent structures. Our objective then is to illuminate upon construction techniques most feasible for temporary/mobile communities. Selection of construction methods is based upon architectural design criteria. In this discussion architectural design criteria is broken into several areas: Architectural Environment, Time-Sharing, Space Types, and Relocation.

ARCH. ENVIRONMENT

"But a consideration of family and community relationships, education, work situations, or any other aspect of the environment, will be superficial unless they are viewed in the context of the structured spaces among which they are experienced. For all these situations and experiences are conditioned by their architectural setting; all are affected, also by the individual's sense of his own identity and worth and by the quality of his motivation and these in turn are subtly and continuously conditioned by his structural environment. . . programs that attempt to solve some of the more important problems to meet some of man's psychological as well as physical requirements, are easily cast aside in the interest of an immediate economy which ultimately proves to have been no economy at all. We should recognize that if we continue to permit the structuring of the physical environment which is essentially hostile, to which man must somehow adapt, the cost to individuals and society will become far too great---in terms of mental illness, delinquency, poor motivation, and the unfulfillment of our capabilities for creative work and community usefulness."[17]

The architectural environment is a critical influence in any community. In a temporary community this factor may be more important. Identity is difficult for many transient individuals to establish, especially for the members of a transient worker's family. The architectural environment can enforce individual identification by establishing a sense of place, inhancing social interaction, defining private areas, etc., or it can distract from an individual's sense of identity and generally lower the quality of life in a community.

A key concern is environmental permanence. Structures can be incorporated into a plan to reinforce a sense of permanence. The structures themselves should also connote stability. Somewhere along the interface of "temporary and permanent" the practicality of various construction techniques has to be evaluated.

TIME SHARING

Spaces should be created in response to the large variety of activities occuring in a community. The shapes of desired spaces will indicate the appropriate type structures. Structure construction becomes greatly narrowed when portability is a major design constraint. Descriptions of construction types and possible use were elucidated in the "State of the Art" section. The concept of time-shared facilities is very applicable to a temporary community. "In most cases, facilities such as gyms, theatres, swimming pools, cafeterias, arts and crafts spaces, libraries, etc. are needed for a variety of both school and community functions but usually at different times during the day, week, and year. Thus instead of building facilities which duplicate each other, facilities are built only once and are time-shared."[18] Essentially time-shared facilities and programs optimize building use and eliminate extraneous structures: therefore lowering: front end money, maintenance costs, relocation time, and relocation expenses (disassembly, transport, and re-erection).

SPACE NEEDS

The following tables indicate the space requirements for various community facilities. The data on these charts is based upon established standards and interpolated standards for permanent facilities. The areas (square footage) represented on the charts are for new town situations where previous facilities are non-existent. When dealing with established communities the planner should consider the present capacity of existing facilities and adjust additional programs accordingly.

The commercial areas charts grid a variety of business activities against three population sizes developed from work force sizes and lists an area (square footage) for a particular enterprise based upon the population of the community. "While families in impacted areas may depend upon larger cities for their major purchases, it is imperative that food, household items, small clothing items, medicines, automotive needs and emergency staples be available within the immediate community."[19]

Commercial facilities such as convenience shops are essential while service facilities such as restaurants and banks will attract people and tend to retain them within the community.

The demand for commercial recreational facilities in a new town will be strong. Commercial recreation such as restaurants, theatres and lounges will cater to the adult population.

Commercial services (banks, auto service, barber shops, beauty shops, motels) will raise the quality of life in the community and increase money circulation within the area. Branch banking is illegal in all of the Old West Region. Savings and loan companies can open branches if their service is not in competition with existing local banks. E.F.T.S. (Electronic Fund Transfer System) may be the answer to the unique banking problems of a temporary/mobile community. An auto service station tends to be a permanent structure where investments are income producing only after a long period of time. Some basic design factors could be altered to overcome this problem (i.e. above-ground tankage, mobile office). A motel will be very beneficial by providing shelter for short term workers and visitors. The motel should be flexible to adjust to demand. The small community may need only 20 rooms when the construction force is low and when population peaks to 2,000 households about 60 units would be desireable.[20]

The RETAIL OUTLETS chart (Table V-2) was developed from estimated buying power per family unit within the community. The chart breaks down retail

GROSS INCOME: RETAIL OUTLETS

SOURCE: U.S. CENSUS OF BUSINESS, RETAIL TRADE (1967) AND "SALES MANAGEMENT" MAGAZINE PUBLISHED BY KEN REISS

TABLE V-2

RETAIL OUTLET TYPE	SALES PER HOUSEHOLD (BASED ON $13,122 ANNUAL INCOME PER HOUSEHOLD)	RETAIL GROSS INCOME FROM COMMUNITY OF 1500 (500 HOUSEHOLDS)	RETAIL GROSS INCOME FROM COMMUNITY OF 3000 (1000 HOUSEHOLDS)	RETAIL GROSS INCOME FROM COMMUNITY OF 6000 (2000 HOUSEHOLDS)
FOOD (GROCERY)	$1,645	$822,000	$1,650,000	$3,290,000
DINING AND DRINKING	$ 780	$390,000	$ 780,000	$1,560,000
GENERAL MERCHANDISE	$1,040	$520,000	$1,040,000	$2,080,000
CLOTHES AND ACCESSORIES	$ 520	$260,000	$ 520,000	$1,040,000
FURNITURE AND APPLIANCES	$ 430	$215,000	$ 430,000	$8,600,000
AUTOMOTIVE SUPPLIES AND SALES	$1,650	$825,000	$1,650,000	$3,300,000
AUTOMOTIVE SERVICE STATION	$ 950	$475,000	$ 950,000	$1,900,000
BUILDING MATERIALS AND HARDWARE	$ 690	$345,000	$ 690,000	$1,380,000
DRUGS	$ 350	$175,000	$ 350,000	$ 700,000
TOTAL RETAIL SALES	$8,660	$4,330,000	$8,660,000	$17,320,000

business types and their estimated gross incomes. The STORE AREAS chart (Table V-3) defines areas based upon national rental rate trends as a percentage of gross income.

All cultural activities could be enclosed in time-shared structures or spaces. For populations from 1500 to 6000 the space requirements will vary: museum 1000 sq. ft. to 2500 sq. ft., library 2000 sq. ft. to 3500 sq. ft., and theatre 1000 sq. ft. to 3000 sq. ft. (100 to 300 seats).

In any stable community worship is a well supported function. To attract any kind of congregation a religion must have a place of worship and a clergyman. Space allocation is relatively simple. Space should be provided for five or six services per week. These spaces can be time shared and only one area is really necessary. The structure of the church should appear permanent to help overcome the temporary nature of the community.

Cultural activities offer women a chance to get away from the home. Either by participating in adult art class, for example, or voluntarily working at the resource desk in the library. Cultural activities can be a very strong binder in the community providing social interaction, entertainment, education, and initiative.

The EDUCATION AREA charts break down the various functional areas of a a school for each type of school (day care Table V-4, elementary Table V-5, secondary Table V-6). Elementary school ranges from grade 1 through 6 and the secondary school includes grades 7 through 12. The data on these charts was developed by Howard Needles Tammen & Bergendoff.

Education is an outstanding factor in the development of the community. Without proper educational facilities it is doubtful that the workers will bring their families to reside with them permanently. The result will be no family balance and the community will develop into a typical male 'Boom Town'.

The scope of education facilities is very dependent upon the population of the community. For example a community of 1,500 people needs an

STORE AREAS AS A FUNCTION OF RETAIL GROSS INCOME

SOURCE: DOLLARS & CENTS OF SHOPPING CENTERS 1975 (URBAN LAND INSTITUTE) AND EXPENSES IN RETAIL BUSINESS (NATIONAL CASH REGISTAR CORP.)

TABLE V-3

RETAIL OUTLET TYPE	GROSS INCOME	RENT AS A PER CENT OF GROSS INCOME	RENT	RENT PER SQUARE FOOT	STORE AREA
FOOD (GROCERY)	$822,000	3%	24,660$	3.12$	7900 S.F.
DINING AND DRINKING	390,000	8%	31,200$	3.28$	9500 S.F.
GENERAL MERCHANDISE	520,000	3%	15,600$	1.60$	9800 S.F.
CLOTHES AND ACCESSORIES	260,000	7%	18,200$	3.60$	5000 S.F.
FURNITURE AND APPLICANCES	215,000	6%	12,900$	1.80$	7200 S.F.
AUTOMOTIVE SUPPLIES & SALES	825,000	4%	33,000$	2.20$	15000 S.F.
AUTOMOTIVE SERVICE STATION	475,000	BASED ON GAS VOLUME		5.50$	
BUILDING MATERIALS AND HARDWARE	345,000	5%	17,250$	2.50$	6900 S.F.
DRUGS	175,000	6%	10,500$	2.20$	4800 S.F.

elementary school and combination junior high and senior high school. Whereas 6,000 people need day care facilities, probably two elementary schools, a junior high and high school. Even the influx of 1,500 people would have a major impact upon the educational system of an existing moderate size town.

Even though most of the women in the community will not have jobs, a day care facility can free their days. They can become more involved in community activities and live a more independent life.

"Man's humanness is due in great part to his massive brain and his reliance on learned behavior as a means of adapting to his environment. Providing people the opportunity to continue intensive learning is one way of giving them a sense of accomplishment. This particularly important in restricted settings."[21] Adult education is another factor to consider. More and more adults are furthering their education. A dynamic community should meet this demand. Many courses can be taught without the use of cumbersome heavy equipment. This is another area where the time sharing concept has proven feasible (evening classes held in school classrooms).

The type of schooling should also be looked into to meet the dynamics of a temporary community. The flexibility of an open classroom approach may prove more relevant to this type of situation.

COMMUNITY SERVICE

The community must provide services such as law enforcement, fire protection, government, maintenance and postal service.

"The experience of areas of previous rapid growth indicates that crime rates are likely to increase in areas where the influx consists of relatively high income families as in areas where it consists of construction workers or other temporary residents."[22] Security is essential to man and

DAY CARE: SPACE ALLOCATION

TABLE V-4

BASED ON HALF-DAY SESSIONS

	SPECIFIC AREAS	COMMUNITY POPULATION: 1500 SCHOOL OCCUPANCY: 47	COMMUNITY POPULATION: 3000 SCHOOL OCCUPANCY: 94	COMMUNITY POPULATION: 6000 SCHOOL OCCUPANCY: 188
ADMINISTRATION	OFFICE	100 SQ. FT.	100 SQ. FT.	120 SQ. FT.
	TEACHER'S LOUNGE	100 SQ. FT.	150 SQ. FT.	200 SQ. FT.
	SUPPLY ROOM	100 SQ. FT.	200 SQ. FT.	280 SQ. T.
MAINTENANCE	SERVICE CLOSETS AND MECHANICAL ROOM	60 SQ. FT.	80 SQ. FT.	90 SQ. FT.
	TOILETS	80 SQ. FT.	80 SQ. FT.	160 SQ. FT.
INSTRUCTION	GENERAL INSTRUCTION	250 SQ. FT.	400 SQ. FT.	600 SQ. FT.
	GROUP ACTIVITY	150 SQ. FT.	200 SQ. FT.	300 SQ. FT.
OUTDOOR PLAY	HARD SURFACE	400 SQ. FT.	400 SQ. FT.	800 SQ. FT.
	FIELD/GREEN	900 SQ. FT.	900 SQ. FT.	1800 SQ. FT.
TOTAL	INDOOR AREA	840 SQ. FT.	1210 SQ. FT.	1720 SQ. FT.

certain factors have to be realized in order to maintain control.

A police force can help maintain order yet that is not enough. The community itself is the single most important factor. The general lack of community activity, interest and services will lend itself to more crime. The community layout and orientation of spaces and buildings can either enhance or deter criminal activity. It is important to optimize residential surveillance via planning.

In a new town situation a police force of 14 people (2 cars) will provide 24 hour service for a population of 1,500 to 2,500 people. 3,000 to 6,000 people will need a staff of 20 (3 cars). Generally a holding facility (until transport to appropriate facility, i.e., county jail) will provide sufficient retention of local lawbreakers.[23] These types of operations are expensive and can be reduced depending upon the degree of security within the community. Good community planning can offer control over many areas without the use of police.

The type of fire protection in a community will vary considerably depending upon population and availability of water. Population will determine the expertise of the fire fighter and amount of equipment necessary. Most energy oriented development will utilize water for cooling, cleaning, transport, etc. Generally communities will incorporate a hydrant system in the infrastructure. The community should have a fire fighting force either professional or voluntary, and have at least one pumper truck.

Some sort of administration or government is essential to the operation and maintenance of the community. (In many instances, the existing town government will extend itself over the new addition if it is located within the government's jurisdiction.) In a new town, some sort of administrative body responsive to the residents will have to be organized. Though the organizational structure will vary, it is important to attract resident interest in government. Many of the problems existing in present "Boom Towns" are the result of lack of personal commitment and disinterest in local politics.[24] A strong community organization will offer identity and a sense of permanence to the

ELEMENTARY: SPACE ALLOCATION

TABLE V-5

ELEMENTARY SCHOOL DENOTES KINDERGARTEN THROUGH SIXTH GRADE

	SPECIFIC AREAS	COMMUNITY POPULATION: 1500 OCCUPANCY: 165	COMMUNITY POPULATION: 3000 OCCUPANCY: 330	COMMUNITY POPULATION: 6000 OCCUPANCY: 660
ADMINISTRATION	PRINCIPAL	120 SQ. FT.	120 SQ. FT.	240 SQ. FT.
	OUTER OFFICE	250 SQ. FT.	250 SQ. FT.	500 SQ. FT.
	SUPPLY ROOM	100 SQ. FT.	100 SQ. FT.	200 SQ. FT.
	TEACHERS' LOUNGE	250 SQ. FT.	350 SQ. FT.	700 SQ. FT.
	TOILET	80 SQ. FT.	80 SQ. FT.	160 SQ. FT.
MAINTENANCE	STORAGE	50 SQ. FT.	100 SQ. FT.	200 SQ. FT.
	SERVICE CLOSET	75 SQ. FT.	150 SQ. FT.	300 SQ. FT.
	MECHANICAL ROOM	200 SQ. FT.	200 SQ. FT.	400 SQ. FT.
FOOD SERVICE	SERVING AREA	100 SQ. FT.	200 SQ. FT.	400 SQ. FT.
	DINING	160 SQ. FT.	320 SQ. FT.	640 SQ. FT.
	RECEIVING & STORAGE	100 SQ. FT.	100 SQ. FT.	200 SQ. FT.
	KITCHEN	650 SQ. FT.	1000 SQ. FT.	2000 SQ. FT.
MULTI-PURPOSE	AUDITORIUM	1200 SQ. FT.	2000 SQ. FT.	4000 SQ. FT.
	GYMNASIUM	1520 SQ. FT.	3040 SQ. FT.	6080 SQ. FT.
	RESOURCE CENTER	300 SQ. FT.	600 SQ. FT.	1200 SQ. FT.
HEALTH CARE	TOILETS	200 SQ. FT.	400 SQ. FT.	800 SQ. FT.
	OFFICE	80 SQ. FT.	80 SQ. FT.	160 SQ. FT.
	EXAMINATION	100 SQ. FT.	100 SQ. FT.	200 SQ. FT.
	WAITING/RECEPTION	60 SQ. FT.	60 SQ. FT.	120 SQ. FT.
GEN. INST	CLASSROOM	6000 SQ. FT.	12,000 SQ. FT.	24,000 SQ. FT.
OUTDOOR PLAY	HARD SERVICE	12,000 SQ. FT.	21,000 SQ. FT.	42,000 SQ. FT.
	GREEN /FIELD	100,000 SQ. FT.	100,000 SQ. FT.	100,000 SQ. FT.
TOTAL	INDOOR AREA	11,595 SQ. FT.	21,250 SQ. FT.	42,500 SQ. FT.

inhabitants.

A maintenance crew either part time or full time will be necessary to maintain community services such as sewers, roads, water lines, refuse disposal, etc.

Postal service is a valuable link in the communication network of the community. This operation could range from a non-manned kiosk (small pavillion) in a plaza to a separate post office building.

A major problem in rapidly developed areas is medical facilities.[25] An optimum solution for the medical problems of a temporary mobile community is a small medical center. This could be staffed by a registered nurse or physician's assistant. A larger staff would be necessary for 24 hour service. Doctors and dentists should be scheduled for certain days and a general practitioner should be on 24 hour call. Various specialists could be scheduled on alternating days. At least one ambulance should be available full time. A medical program should be designed for a specific community depending upon existing facilities, proximity to back-up units, working hours, population, etc.

A medical facility of 800 square feet would be sufficient for a population of 1,500. This size facility would include: reception area, doctor's office, records area, examination room, laboratory, x-ray room, and minor operating room. The medical area to service 6,000 people would be a minimum of 1,200 square feet. A medical building could possibly be sited close to schools to accommodate the required nursing program.

The COMMUNITY SERVICE chart (Table V-8) defines the service function and allocates areas based upon community population.

A community center is a basic need of a temporary community. The center would house a variety of spaces from public to private. The structure should be designed around a large, flexible community area (2,000 square feet for one neighborhood). This area would be used for dinners, parties, worship, or any community function involving many people. Other smaller

SECONDARY: SPACE ALLOCATION

TABLE V-6

SECONDARY SCHOOL DENOTES SEVENTH THROUGH TWELFTH GRADES

	SPECIFIC AREAS	COMMUNITY POPULATION 1,500 SCHOOL OCCUPANCY 94	COMMUNITY POPULATION 3,000 SCHOOL OCCUPANCY 188	COMMUNITY POPULATION 6,000 SCHOOL OCCUPANCY 376
ADMINISTRATION	PRINCIPAL	120 SQ. FT.	120 SQ. FT.	120 SQ. FT.
	COUNSELOR	200 "	200 "	200 "
	OUTER OFFICE	250 "	250 "	300 "
	SUPPLY ROOM	100 "	100 "	200 "
	TEACHER'S LOUNGE	250 "	500 "	500 "
	TOILET	80 "	80 "	80 "
MAINTENANCE	STORAGE	100 "	100 "	200 "
	SERVICE CLOSET	75 "	100 "	150 "
	MECHANICAL ROOM	100 "	200 "	200 "
FOOD SERVCIE	SERVING AREA	100 "	100 "	200 "
	DINING	100 "	200 "	400 "
	RECEIVING & STORAGE	100 "	100 "	100 "
	KITCHEN	350 "	600 "	1000 "
MULTI-PURPOSE	AUDITORIUM	1000 "	1500 "	2000 "
	GYMNASIUM	5590 "	7500 "	10,400 "
	RESOURCE CENTER	500 "	1000 "	1,500 "
HEALTH CARE	TOILETS	100 "	200 "	400 "
	OFFICE	80 "	80 "	100 "
	EXAMINATION	100 "	100 "	150 "
	WAITING/RECEPTION	60 "	60 "	60 "
GEN. INST.	CLASSROOMS	2400 "	4000 "	7600 "
	SPECIAL FACILITIES	800 "	2400 "	4800 "
OUTDOOR PLAY	HARD SURFACE	5000 "	10,000 "	10,000 "
	GREEN/FIELD	200,000 "	200,000 "	200,000 "
TOTAL	INDOOR AREA	12,500 "	19,490	30,660 "

spaces should be provided for television viewing, card playing, meetings, etc. A community center could develop into something more than a social center by incorporating local government offices or a post office within the structure.

Space allocation for residences will vary greatly with the size of the family. Current manufactured mobile homes range from 500 square feet to 1,500 square feet. The number of mobile homes necessary would be directly related to the construction labor force. The average dwelling unit would be between 800 to 900 square feet. Approximate total dwelling area for the three communities would be: 400,000 square feet (1,500 pop.); 800,000 square feet (3,000 pop.); and 1,600,000 square feet (6,000 pop.).

RELOCATION

The efficiency of disassembly and relocation of architecture is an outstanding factor in the feasibility of a temporary community venture. The criteria for evaluating portability consists of time and cost. The ideal situation would involve no disassembly of structures, simple and fast transportation, and use of less expensive unskilled labor for the entire operation. Mobile homes conform to this criteria better than long span structures.

Except for double-wides, mobile homes require little disassembly. The structure, plumbing, wiring, heating, and furnishings are integral with the unit. Supplemental elements such as the foundation and utility service lines will be discussed later in this section. Transportation is simple because all mobile homes have under carriages designed for towing. Highway transport is relatively inexpensive at approximately $1.00 per mile. Site installation involves unit placement upon the foundation and connection of utility lines. Deterioration through use and excessive hauling are other variables affecting feasibility.

COMMUNITY SERVICE: AREAS

SOURCES: CASPER POLICE DEPT. AND BRUCE MARTIN (G.P.O.)

TABLE V-7

	COMMUNITY OF 1500	COMMUNITY OF 3000	COMMUNITY OF 6000	SPECIFIC AREAS
FIRE PROTECTION	800 SQ. FT.	800 SQ. FT.	800 SQ. FT.	GARAGE FOR ONE PUMPER TRUCK (650 SQ. FT.) STORAGE FOR EQUIPMENT (150 SQ. FT.) KITCHEN AND MEETING ROOMS CAN BE LOCATED IN A TIME-SHARED FACILITY
GOVERNMENT/ ADMINISTRATION	400 SQ. FT.	400 SQ. FT.	600 SQ. FT.	ADMINISTRATOR'S OFFICE (200 SQ. FT.) SECRETARIAL SPACE AND STORAGE (200 SQ. FT.) ADDITIONAL SPACE COULD BE PROVIDED TO HOUSE COUNCIL MEETINGS (200 SQ. FT.)
COMMUNITY MAINTENANCE	500 SQ. FT.	500 SQ. FT.	1000 SQ. FT.	OFFICE AREA (100 SQ. FT.) STORAGE FOR EQUIPMENT'S SUPPLIES (400 SQ. FT.) ADDITIONAL AREA FOR STORAGE
LAW ENFORCEMENT	1000 SQ. FT.	1000 SQ. FT.	1500 SQ. FT.	HOLDING AREA (JUVENILE & ADULT/MALE & FEMALE) RESTROOMS (STAFF & PRISONER) EVIDENCE ROOM, OFFICE, SQUAD ROOM
POST OFFICE	1200 SQ. FT.	2000 SQ. FT.	4000 SQ. FT.	BOX AND SERVICE LOBBIES WORKROOM RESTROOMS

Long span structures will require extensive disassembly compared to mobile homes. Except for air structures all current long span construction is designed for permanent installation. Plumbing, wiring, heating and furnishing are usually extraneous to the structure. Such buildings can be broken down into structural components such as columns and beams or struts and the exterior skin such as siding or roof panels. After disassembly these components have to be loaded for transport. Trucking is the most economical per unit method of transportation. Installation is involved and will require skilled and unskilled labor. Site grading and footing excavation would be necessary. Generally new foundations and concrete floors will have to be constructed. The increased handling due to disassembly will increase the deterioration of components.

The installation/relocation system should adapt itself readily to community needs based upon the size of the construction labor force. Mobile homes are flexible in that they can be added or subtracted from a settlement relatively easily. The long span community structures are not as adaptable due to construction techniques and population has to alter considerably before installation or relocation is warranted.

ENGINEERING

The current state of construction technology for temporary/mobile facilities varies with specific needs. Utility service line systems have recently been designed with portability in mind whereas town planning elements such as roadway construction have never been engineered for efficient use in temporary situations. Treatment facilities and some structure types have been designed to adapt to temporary/mobile conditions. The following text outlines engineering design criteria for: utility layout, disposal and treatment facilities, road construction and relocation/disassembly concepts.

UTILITY NETWORK

The utility network (infrastructure) necessary for a town of up to 6,000 people will include: water and waste water service and treatment, power supply and linkages, drainage considerations, refuse collection and disposal, roadways and telephone service. The development of all the services will vary depending upon population, topography, geology, and existing facilities. The optimum situation would be to have the infrastructure as portable as the architecture of the development. That means reuse of all piping, valves, equipment, etc. The reuseable infrastructure would have to be flexible enough to adapt to a variety of conditions which will change with each locality. The system would also have to be economical to install and remove. Deterioration due to handling and use should be minimal. Considering these constraints many systems are eliminated and others emerge as more applicable to temporary/ mobile conditions.

WATER SYSTEM

"When feasible, water should be obtained from an approved public water-supply system. Where public water supply systems are not available within a reasonable distance for extension to a mobile home development, the best available private water-supply source should be developed and constructed in accordance with plans approved by the health authority."[26] The water supply will differ greatly with location. Availability may be simple because energy resource developments will utilize water for steam power generation, mineral separation, cooling, etc. No matter what the water source is, treatment of some kind is essential to protect the health of the residents. We recommend a modular or component treatment system so components can be added or subtracted depending on the current demand. Piping systems will vary according to geology, topography and demand.

The average mobile home needs between 250 and 300 gallons of water each day. A minimum flow pressure of 20 psi will have to be maintained at all service connections but we recommend 35 psi. A neighborhood of 500 dwellings should have a maximum water demand of about 500 GPM, 1,000 dwellings require 800 GPM, and 2,000 dwellings would need 1,200 GPM. An 8 inch main can handle 1,200 GPM with low head loss. The entire water supply system should be looped to prevent residue build-up. The lateral lines could be 6 inch and the dwelling service line should be standard 3/4 inch diameter pipe. "The hydrants or other water supply facilities should be so arranged as to permit the operation of a minimum of 2 1-1/2 inch hose streams (75 gallons/minute) on any fire that might occur."[27]

Water pipe is made from a variety of materials but, plastic (polyvinylchloride) looks like the best way to go. Plastic pipe is generally the least expensive and its lightweight is also desirable. Plastic pipe can be installed by a small crew with no heavy equipment (i.e., cranes) necessary to move it. Its lightweight also makes it more economical than other pipe to transport.

SEWERAGE SYSTEM

"If possible, the sewerage system of a mobile home development should be connected to a public sewerage system. If public sewers are not available within a reasonable distance of the mobile home development, adequate treatment facilities must be installed to dispose of the waste water. Any proposed waste water disposal facilities should be approved by the health authority or other regulatory agency. The effluent from such treatment facilities should be discharged only as permitted by these agencies."[28]

The type of sewerage system to be used can be either gravity flow or pressurized. This selection will depend on geology and topography of the area and whether a local system exists. Again the modified existing system or new system should be modular to increase flexibility. Low volume flush toilets should be used in the dwelling units to reduce water use and reduce waste treatment.

The major benefit of a pressurized system is its versatility. The topography could widely vary within a community or from community site to site and a pressurized sewer can readily adapt. The major advantage of the gravity flow sewer is lower cost, but for an undulating terrain installation the excavation costs for a gravity system could be extreme. The installation would be slow and reclamation of the sewer pipe would be difficult and expensive. A pressurized system would also be a good choice when it is used in conjunction with a portable piping system. A portable piping system usually follows the local topography whether it is laid below grade or elevated; therefore, a force main would be necessary to move the waste water.

Even though the pressurized system requires smaller diameter pipe the extra expense results from pumping stations. Sump pump tanks and pumps can either be located under each dwelling unit or situated as a common pump station for several mobile homes. Generally the more common pump stations used as opposed to individual dwelling pumps, the less expensive is the total collection system. The size of the pump will vary from 1/2 to 3 H.P. depending upon volume and head loss.

Sizing of piping is difficult because each location of a community sewerage system is unique. Some sizes based upon average demands and conditions because universal sizes are more practical for reuse situations, are as follows. The gravity sewer main should be 8 inches, the laterals 6 inches, and the dwelling service lines 4 inches in diameter. Pressure sewer sizing is also dependent upon local conditions. The minimum sizes should be 2 inches where individual pumps are used or 3 inches where many units use a common pump station. There is a variety of sewer pipe on the market, but plastic pipe is the most applicable for our situation. The cost of the pipe is less than any other type except vitrified clay tile but the installation of plastic is much simpler and less expensive.

SOLID WASTE DISPOSAL

Public health problems are often associated with improper storage, collection, and disposal of solid waste. There are significant relationships between the incidence of certain diseases in humans and in animals and the improper handling of solid waste . . . experience has shown that application of the basic principles of sanitation to the handling of solid waste results in substantial reductions in insects, rodents, and related health problems.[64]

Trash collection points could be located in housing clusters. Pre-land fill solid wastes must be stored in a durable, non-absorbent, water tight, rodent-proof, easily cleanable container and have a wind proof, fly tight cover. Dumpster type units could be used as moveable containers pulled to the disposal area for dumping or dumped into garbage trucks and hauled to the treatment area. If a local disposal facility exists, collection and disposal operations could simply be increased to accommodate more waste. If existing facilities cannot expand or no community facility is available then a disposal system will have to be developed.

Methods of limiting the amount of disposable materials should also be considered. Local stores could select recyclable packaging for their stock items. A separate disposal for materials which might be easily sold or recycled could possibly be implemented. Installation of trash compactors and garbage disposals in the dwelling units will greatly reduce refuse handling. Refuse collection can be handled with communal drops instead of individual trash storage areas. Compacted trash makes this operation much more convenient than handling bulk refuse.

POWER

Electricity is the most sensible power source for a mobile/temporary community. Electric power can be made available relatively easily as opposed to other contemporary power sources. Electrical power plant construction is necessary to provide power for many mineral extraction and processing operations. A support community should have few problems tapping into this power supply, if the power plant is operating before the impact. The cost of electric power transmission lines or generating plants will be an intrinsic part of the initial community cost. Generally whatever power source exists in the area it will be less expensive to tap this local source. Electrical appliances installed in dwelling units will be more adaptable yet natural gas is a more efficient fuel for heating. Reducing the amount of infrastructure is a major engineering criteria and adding an extra power service line will hinder the "mobility" concept.

The ideal solution to the power problem would be to have each dwelling unit and community structure generate its own power. Electrical power could be generated from solar or wind energy making each unit self-sufficient. Wiring would be limited due to the immediate position of the power source which means service lines could be completely eliminated thereby expediating installation and relocation. A few companies are experimenting with solar heat as a power source for mobile homes but no practical units of this type are currently being marketed.

Power line installation can be handled in two ways either above ground or below ground. Both methods have different advantages. Below grade installations are more aesthetically pleasing while above ground lines are less expensive. We suggest the combination of the two systems. The transmission lines could be supported by utility poles and the service lines to the dwellings could be placed underground. Transformers could be ground mounted and should be located inconspicuously to inhance overall visual appearance. The utility poles could be "decorative" and double as lighting supports. The main power lines, utility poles, and transformers could be disassembled and reinstalled. The service connection between the transformer and dwelling is relatively inexpensive and could be abandoned with the site.

All the appliances and heating and cooling systems of the mobile homes should operate on electric power. Fifty amp service lines would provide ample power to dwellings. The community power source should be able to adapt to the demands of the residnets. A population of 1,500 requires a generator output of 2,000 kilowatts/hour, 3,000 people need 4,000 kilowatts/hour, and 6,000 people need 8,000 kilowatts/hour.

PORTABLE PIPING

An efficient portable piping system could enhance the economic feasibility of a temporary community. The most practical application is for main distribution and collection lines. The service lines from dwellings or other structures to the mains should be installed underground by conventional installation methods. When evaluating a portable piping system for possible use in a temporary community, the following factors should be considered:

- Ease of assembly and disassembly
- Weight and amount of components
- Manufacture techniques (production should be geared to adapt to updated designs)
- Climatic limitations
- Functions available (i.e., main line, lateral, or service)
- Aggregate accommodation (i.e., combinations of different line pipes such as water, sewer, etc., within one main duct or pipe)
- Flexible installation techniques (i.e., above ground, underground, etc.)
- Costs (i.e., initial, maintenance, etc.)

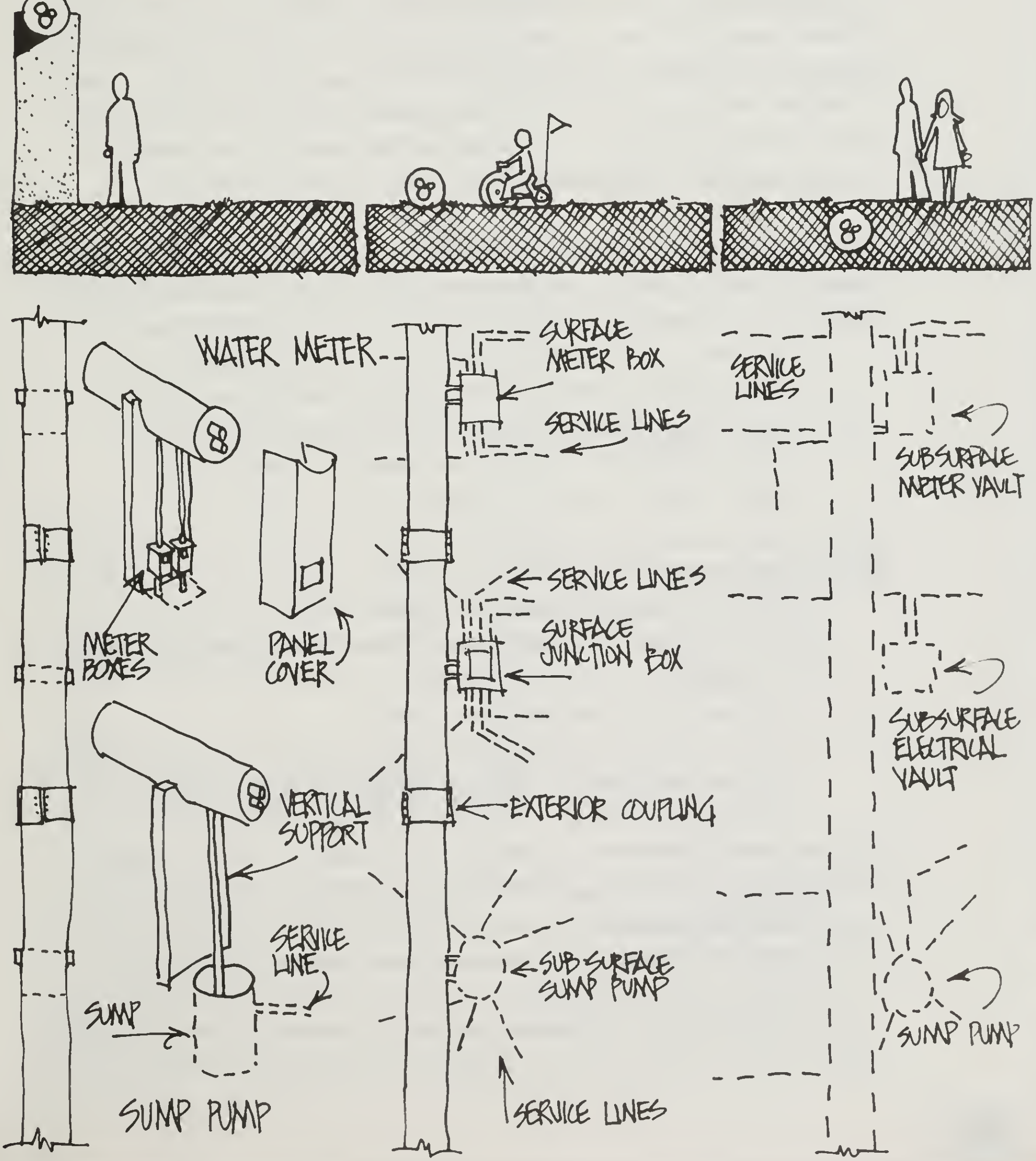
Currently the number of manufacturers of portable piping systems (see Appendix) is small in number.

The most popular system today is made up of four basic elements: jacket, insulation, carrier line and connection. The insulation is urethane which will adhere to a wide variety of materials. Since urethane foams bonding capacity is so versatile and its expansion/contraction characteristics perform well with almost any adjoining materials, the jacket and carrier line materials that can be used are numerous (i.e., plastics and metals). The common jacket material is aluminum helical corrugated culvert pipe which is lightweight and possesses good structural qualities. Plastic piping (P.V.C. or polyethylene) is usually the carrier pipe/s, but like the jacket material, selection is flexible. Plastic pipe is lightweight and joining is relatively simple (bell coupling for fluid carrier pipes). A fifth element may also have to be considered depending upon the climate at the installation site. A heat source would prevent

PORTABLE PIPING: INSTALLATION TYPES

ELEVATED ON GRADE SUB GRADE

FIGURE V-6



water lines from freezing. Heat tape or heat tracing are widely used for this purpose. Another concept such as circulating heated water in the water supply line may prove practical.

For illustration it is assumed that water, waste water, and power carrier lines would be contained within the culvert pipe. Demand loads will establish water, waste water, and power line diameters. Assuming the water main will be 8 inches (potable source and fire protection), waste water collector 6 inches (pressurized sewer), and 3 inch conduit to contain the power line. A 24 inch diameter jacket would provide at least 5 inches of insulation surrounding the above carrier assembly. For this example we have chosen P.V.C. for all carrier lines.

Three alternative installation methods for portable pipe are: elevated above, resting on, or placed under the ground. Each method has certain advantages and drawbacks. The advantages of the elevated method are:

- Requires no excavation except for vertical supports
- Makes repairs simple since the pipe is readily accessible
- Permits easy access for connection of service lines
- Offers versatility such as the overhead structure could support light fixtures, telephone lines, etc.

The disadvantages of this approach are:

- Require a mechanical hoist to install pipe
- May be aesthetically undesirable because the utility system is exposed
- Must run longer service lines to main
- Must use more main piping at street crossings to provide adequate vertical clearances or to neck piping down under roadway

When the support structure is removed, the ground is then the support. The advantages of an on the ground installation are:

- Requires no supports
- Makes installation, maintenance, and disassembly relatively simple
- Requires minimal excavation except to level an installation route

The disadvantages are:

- May be aesthetically undesirable because the system is exposed
- Takes up ground area (important if system located in pedestrian spaces)
- Acts as a physical restriction to vehicles and pedestrians

Another method is a shallow below grade installation. The advantages of a subsurface installation are:

- Does not take up any usable surface area so it is not a physical barrier or visual obstruction
- Requires no support structure
- Simplifies recovery operation in relation to a conventional, subfrost penetration system

The disadvantages of employing this method of installation in a mobile/temporary community are:

- Installation
- Repair is difficult
- Removal for relocation is difficult and component losses tend to be higher.

All things considered the final decision of which portable installation method to use will depend on money. As a cursory observation an on the ground installation would probably be least expensive. This is a relatively new method with limited application in the United States. Additional study is needed to define alternatives and costs.

MOBILE HOME STAND

"A stand should be provided on every mobile home lot to accommodate the mobile home and its attached structures. The stand should provide an adequate foundation and anchoring facilities to secure the mobile home against any accidental movement. The mobile home stand should be graded to obtain adequate surface drainage."[30] The stand will also be the interface between utility connections from the service line to the dwelling.

We recommend that the mobile homes of the community be limited to a few sizes and configurations. This would greatly expedite the installation of foundations and utility risers.

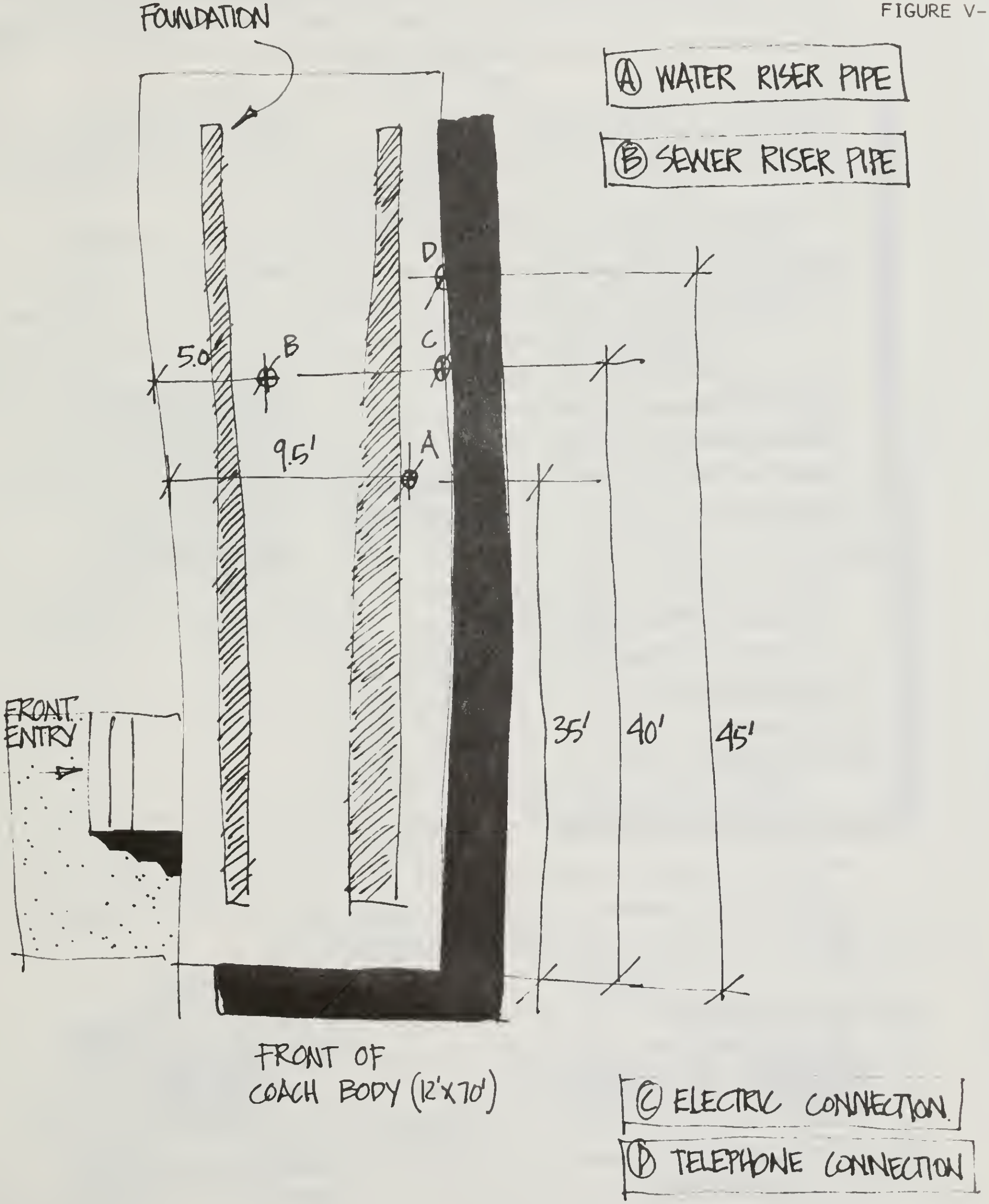
Foundation types for mobile homes can vary depending upon duration of location and soil conditions. Ideally the undercarriage or at least the wheels should be removed and a foundation used to visually tie the mobile home to the earth. In a temporary situation this type of installation would be costly and other methods may prove more economical. Figure V-7 (Foundations and Tie Downs) shows a possible solution by utilizing railroad ties or heavy timbers for the "footing" and foundation walls. F.H.A. approved pre-fabricated wood foundations or even metal truss system could be used in place of the timber foundation wall. These types of foundation system would be relatively inexpensive and quite portable. Another method of installation would be to leave the wheels attached to the undercarriage and just excavate enough earth below the wheels so a foundation will support the unit with no load on the axles.

"Tie downs offer the most consistent and effective means for minimizing mobile home damage from high winds. Two types of ties are needed: (1) the over-the-top tie and (2) the frame tie. The first keeps the unit from overturning and the second prevents it from being blown off the supports."[31] The Civil Defense Preparedness Agency recommends both types of tie-downs for 10 feet to 16 feet wide units and double wides (24 feet) require only frame ties. See Figure V-7 for the down anchorage requirements and illustration of tie-downs.

The utility service risers should be located according to service outlets in each mobile home. The illustration (Figure V-8) is a typical stand installation. If similar sized mobile homes make up the residential sector of the community installations could be standardized. "The water service connection should utilize a riser pipe of at least 3/4 inch diameter terminating at least 4 inches above ground . . . A service box with shut-off valve should be located in a convenient and accessible place near the riser pipe. The sewer riser pipe should be located so

M.H. STAND: RISERS

FIGURE V-7



THIS PICTURE INDICATES APPROXIMATE LOCATIONS FOR SERVICE CONNECTIONS. WHEN MOBILE HOMES ARE SELECTED, SERVICE LOCATION SHOULD CORRESPOND TO EACH PARTICULAR MOBILE HOME.

that it provides a near vertical connection between the riser pipe and the drainage outlet of the mobile home. Electrical, telephone, and gas connections can be located wherever they will be most convenient . . "[32]

TREATMENT SYSTEMS

If a temporary mobile development is incorporated into an existing community or a new town, water and sewage treatment and solid waste disposal operations will have to be expanded or initiated. All systems should be engineered for each particular situation. Treatment facilities will vary depending upon demand loads and local conditions. Relocatable, modular treatment systems are desirable because components can be added or subtracted and reused. Generally an existing solid waste disposal operation can be expanded easily but the implementation of a new disposal system will require more investigation.

A water analysis is essential for the selection of a water treatment facility even for add-on applications. A water analysis will establish:

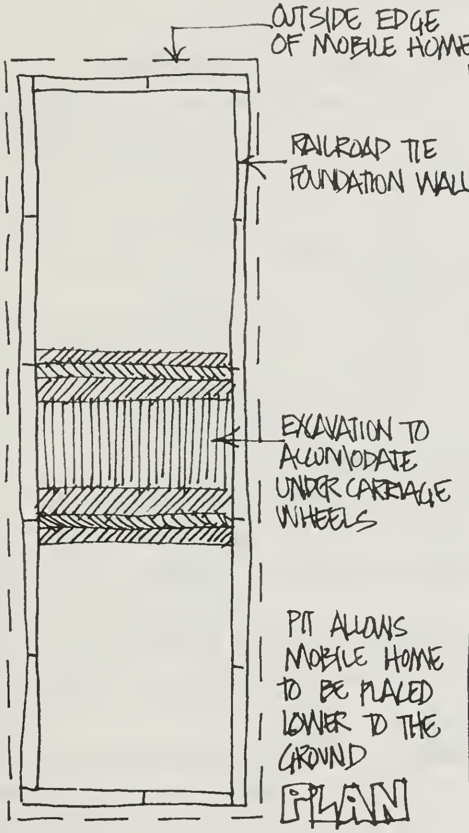
Total dissolved solids (T.D.S.)
Coliforms
Hardness
Turbidity
Acid-Akali Content (pH)

The water treatment chart (Table V-9) lists several manufacturers of modular water treatment systems. It illustrates some of the systems easily available in the Rocky Mountain area.

Since it would take volumes to illustrate the choice determinations, the more important aspects will be covered briefly. Reverse osmosis or physical/chemical plants will lower T.D.S. considerably. Hardness in most cases will have to be reduced by either ion exchange or a lime-soda method of softening. Coliforms can be reduced by coagulation, floculation, filtration and chlorination (utilized in all treatment plants). Turbidity will be removed by filtration, gravity sedimentation, and coagulation and floculation. The pH can be adjusted during sedimen-

FOUNDATION IDEA & TIE DOWN NEEDS

FIGURE V-8


OUTSIDE EDGE OF MOBILE HOME
RAILROAD TIE FOUNDATION WALL
EXCAVATION TO ACCOMODATE UNDER CARRIAGE WHEELS
PIT ALLOWS MOBILE HOME TO BE PLACED LOWER TO THE GROUND
PLAN

90 M.P.H.

DESIGN WIND VELOCITY WILL BE SUFFICIENT FOR ALL THE OLD WEST REGION TIE DOWN REQUIREMENTS

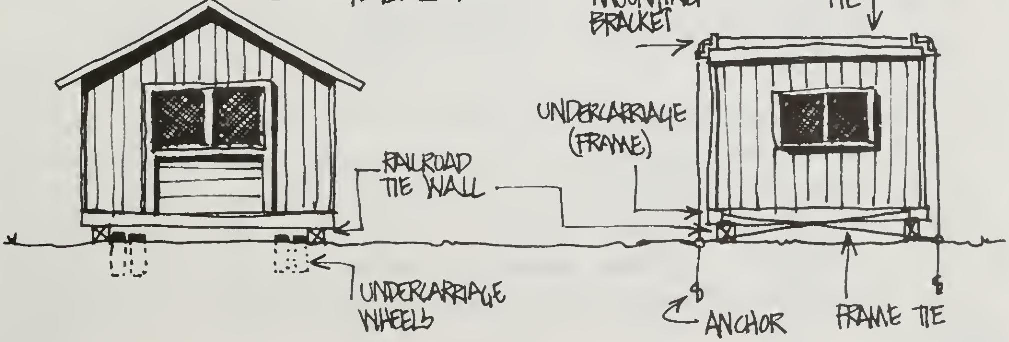
TIE DOWN COMPONENTS MUST BE ABLE TO WITHSTAND @ LEAST 4750 LBS.

24 FT. WIDE MOBILE HOMES DO NOT REQUIRE ANCHORAGE

MOBILE HOMES 12 FT. TO 14 FT. WIDE & 60 FT. TO 70 FT. LONG WILL REQUIRE:

7 FRAME TIES **4** OVER THE TOP TIES

ELEVATIONS



tation and by chemical means. All the treatment facilities charted can handle any of the aforementioned situations.

Wastewater treatment is a major concern in the development of any community. Once the need for a wastewater treatment installation is established some criteria must be reviewed to make an intelligent selection of treatment types:

- What is the capacity of the local facility if one exists.
- Is there a need for resource recovery.
- How will sludge be disposed of.
- How many maintenance operators and how much training do they require to maintain the facility.
- Does the effluent meet environmental standards.
- How much is the operating and maintenance costs.
- Does the system require a holding tank.
- What kind of shock load can the system withstand.
- Is there any additional equipment or facilities, i.e., buildings, tankage, chlorinators, etc., necessary for operation.

This list of selection criteria should serve as a guideline only after the type of effluent and waste created by the community is determined.

Table V-9 is by no means a complete cross section of the current waste treatment industry. The chart identifies some of the better systems available in the Rocky Mountain area. All the systems are relocatable. The Pemberthy and Lyco unit is designed to work with or without an existing treatment facility.

DISPOSAL TECHNIQUES

After a collection program is established the disposal of solid waste can take several directions. A resource recovery operation collects various materials from a dumping ground to be recycled. This system uses expensive equipment, but over a period of time the operation would pay for itself. Another drawback is that the equipment is bulky and relocation would be expensive. However, a permanent recovery station

WATER TREATMENT

EQUIPMENT FOR HANDLING 50,000 GALS./ DAY (500 PEOPLE)

TABLE V-8A

TREATMENT TYPE	SERVICES	INSTALLATION			FABRICATION				MAINTENANCE			SIZE
		WHO	TECHNICAL ASSISTANCE	ORDER AND INSTALLATION TIME	OFF SITE	ON SITE	COMBINATION	LOCAL CONSTRUCTION	OPERATOR	OPERATOR TRAINING	AMOUNT OF TRAINING	
EQUIPMENT TO HANDLE EXTREME WATER CONDITIONS												
CONTINENTAL WATER CONDITIONING CORP. (REVERSE OSMOSIS)	⁑DESIGN & SUPPLY ENTIRE SYSTEM ⁑2 YEAR GUARANTEE ⁑CLEAN FILTER ANNUALLY	MANUFACTURER	YES	90 DAYS			X		X	MODERATE	MINIMUM TO MODERATE	5'X3'X3'4"
INTERNATIONAL MARKETING RESEARCH (P/C TREATMENT)	SERVICE CONTRACT CAN BE ARRANGED	OTHER THAN MANUFACTURER	YES	60 DAYS			X	X	X	MINIMUM	MINIMUM	
NEPTUNE MICRO-FLOC, INC. ('AQUARIUS' 'WATERBOY')	SERVICE CONTRACT	SUBCONTRACTOR	YES	20 WEEKS			X		X	MODERATE	MINIMUM	APPROXIMATE 35'X60'X23'
PRECIPATATOR, INC. (P/C TREATMENT)	SERVICE CONTRACT CAN BE ARRANGED	SUBCONTRACTOR	YES	90 DAYS	X		X	X	X	MODERATE	MINIMUM TO MODERATE	35'X60'X23'
FILTER TYPES TO HANDLE GENERALLY POTABLE WATER												
GRAVITY, RAPID SAND, PRESSURE & DIATOMACEOUS EARTH	VARIES W/ MANUFACTURER	SUBCONTRACTOR	X		FILTER MEDIA ADDED ON AT SITE				X	MODERATE	MODERATE	VARIES

could be located at a common area to be used by several communities in the area.

The size of this service area could be increased if drop boxes were used. Drop boxes are another disposal technique in which trash is collected in a semi-truck trailer and hauled to a landfill or recovery station. A typical 40 ton box for a community of 6,000 would have to be picked up about every four days. The success of this operation would depend upon economics and vary with landfill installation and operating costs versus transportation and dumping expense.

Incineration is another technique used for solid waste disposal. The incinerators used for waste disposal are usually designed with all E.P.A. requirements in mind(air, land, etc.). This method of waste disposal will one day replace the total landfill method due to rising land costs, soil conditions, and time considerations. The incinerator itself can be portable, the ashes however, have to be disposed of properly and the equipment has limited use whereas a landfill uses excavation equipment which could be used for many jobs and is quite portable. A landfill appears to be the most economical disposal method.

A combination of the trench landfill method and the area method in conjunction with either shredders and/or compactors is the most efficient landfill treatment operation. The major expense of a landfill is the ongoing costs of turning over or burying the refuse. Since installation and operation are relatively simple we recommend the trench/area landfill disposal method unless a local disposal program could adjust to the impact. It should be noted that solid waste disposal methods will depend upon topography, local, state and municipal regulations, and the types and quantities of waste to be disposed of.

ROADWAYS

Roadways and drainage are another system important to the layout of a community. Roads should be constructed of suitable local materials to

WATER TREATMENT

TABLE V-8B

CONTINUED FROM PREVIOUS PAGE

MANUFACTURER	RELOCATION		TRANSPORT			COST	COMMENTS
	DISASSEMBLY	EXPERIENCE	HIGHWAY	RAILROAD	RANGE		
	EQUIPMENT TO HANDLE EXTREME WATER CONDITIONS						
CONTINENTAL WATER CONDITIONING CORP. REVERSE OSMOSIS	SIMPLE	YES	X	X	OPEN	50,000$	※ EXCELLENT FOR WATER WITH HIGH T.D.S. ※ SIZE DEPENDS ON WATER TEMPERATURE ※ NEEDS SOFTNER
INTERNATIONAL MARKETING RESEARCH P/C TREATMENT	SIMPLE	YES	X	X	OPEN	100,000$	※ FOR EXTREME APPLICATIONS ※ EXCELLENT FOR USE WITH BRACKISH WATER AND RECYCLING OPERATIONS ※ SLUDGE QUALIFIES FOR CLASS II LANDFILL
NEPTUNE MICRO-FLOC INC. 'AQUARIUS' 'WATERBOY'	SIMPLE	YES	X	X	OPEN	25,000$	※ PRIMARY AND SECONDARY TREATMENT ※ IF WATER IS HIGH IN T.D.S. THEN NEEDS ADDITIONAL EQUIPMENT (I.E. SOFTNER, R.O. ION EXCHANGE)
PRECIPITATOR INC. P/C TREATMENT	SIMPLE IF STEEL TANKAGE	NO	X	X	OPEN	300,000$	※ SAME AS INTERNATIONAL'S TREATMENT FACILITY ※ SLUDGE HANDLING EQUIPMENT IS OPTIONAL
FILTER							
GRAVITY RAPID SAND PRESSURE DIATOMACEOUS EARTH	SIMPLE TO MODERATE	NO	X	X	OPEN	VARIES 300,000$ TO 15,000$	※ USEFUL FOR MOST WATER RESOURCES ※ ADDITIONAL EQUIPMENT (CHLORINATION) FOR HIGH T.D.S. OF TURBIDITY

minimize cost since a roadway is not relocatable. Drainage is not a major problem due to the generally light rainfall in the Old West Region. Storm sewers therefore will usually not be necessary.

In a community there are basically three types of roads. The community road is the major vehicular artery such as the main street of a town. The service road or neighborhood street is the road along which the residential sector is linked to the arterial streets. The residential driveway and parking area is not actually a roadway, yet it requires a surfacing of some kind. The type of surfacing will vary depending upon volume and type of traffic, existing soil conditions, availability of materials and the expected life-span of the community.

There are six general types of surfacing most commonly used for roads and streets. The following are listed as a rule of thumb in descending order or strength and cost:

- Portland Cement Concrete Pavement
- Plant Mix Bituminous Pavement
- Road Mix Bituminous Pavement
- Soil-Cement Pavement
- Soil-Lime Pavement
- Crushed Stone or Slag Surfacing

Portland Cement concrete would not normally be used for a temporary installation. The initial cost is greater than the other five and unless that expense together with maintenance charges are pro-rated over a minimum of 20 years service life, its cost would not be economically competitive.

Hot plant mix bituminous pavement like Portland Cement pavement, is most generally used on high quality, permanent facilities. Placement of this type surfacing also requires more sophisticated equipment than needed for the other four types. Required equipment includes a bituminous mixing plant, hauling equipment, bituminous paver and rollers. This surfacing would probably not be used unless the road had a high volume of heavy truck traffic and was expected to remain in use for at least 10 years.

WASTE WATER AND SEWAGE TREATMENT

TABLE V-9A

EQUIPMENT LIMITED TO RELOCATABLE UNITS WITH A 50,000 GAL/DAY HANDLING CAPACITY (500 PEOPLE)

MANUFACTURER	SERVICES	INSTALLATION			FABRICATION				MAINTENANCE			SIZE
		WHO	TECHNICAL ASSISTANCE	ORDER & INSTALL TIME	OFF SITE	ON SITE	COMBINATION	LOCAL CONST.	OPERATOR	OPERATOR TRAINING	AMOUNT OF TRAINING	
AIRCO CYPROPLANTS	WEEKLY CHECKS & PREVENTATIVE MAINTENANCE	SUB-CONTRACT	YES				X	X	X	MODERATE TO EXTENSIVE	MODERATE TO EXTENSIVE	NOT AVAILABLE
AIR-O-GEST SEWAGE	SET-UP CHECKS/CHECK 4 TIMES	OTHER THAN MANUFACTURER	YES	90 DAYS	X			X	X	MINIMUM TO MODERATE	MODERATE	24' WIDE 30' LONG 11' HIGH
AUTO-TROL BIO-SURF	FULL SERVICE & TECHNICAL ASSISTANCE	OTHER THAN MANUFACTURER	YES	16 TO 20 WEEKS	X			X	X	MINIMUM	MINIMUM TO MODERATE	VARIES DEPENDING UPON SITUATION
INTERNATIONAL		OTHER THAN MANUFACTURER	YES	2 MONTHS			X	X	X	MINIMUM	MINIMUM	
MET-PRO SYSTEMS	SET-UP CHECKS	OTHER THAN MANUFACTURER	YES	90 DAYS	X			X	X	MINIMUM	MINIMUM	400 SQ. FT.
NEPTUNE MICRO-FLOC		SUB-CONTRACT	YES	22 WEEKS	X		X	X	X	MINIMUM TO MODERATE	MINIMUM TO MODERATE	BUILDING 60 X 30 FT.
PRECIPITATOR, INC.	SERVICE CONTRACT CAN BE ARRANGED	OTHER THAN MANUFACTURER	YES	90 DAYS			X	X	X	MINIMUM TO MODERATE	MODERATE	35' X 60'
SANILOGICAL	FULL SERVICE	COMBINATION	YES	4 WEEKS			X	X	X	MINIMUM	MINIMUM	
PEMBERTHY & LYCO	VARIES WITH THE PARTICULAR SITUATION											

Road mix bituminous pavement is most commonly used on temporary roads, because of its relative low initial cost, ease of maintenance and minimum equipment requirements. A minimum section would include a 4" to 6" aggregate base and about 2" of asphalt. This type of mix, as well as the plant mix, requires a good quality, hard aggregate which is not readily available in all areas of the Old West Region. In the absence of acceptable aggregates, a soil-cement or soil-lime pavement is usually an acceptable alternative. A mine access road in Converse County, Wyoming is one example of soil-cement being used due to the lack of suitable aggregates. Equipment for placing road mix pavements include mechanical spreading devices for aggregates, bituminous distributor, blade grader and roller.

Soil-cement and soil-lime surfacing is a viable alternative where aggregate is scarce or in those areas having a highly plastic soil such as bentonite. The cement or lime reduces the plasticity of the soil when exposed to water. Equipment required includes a blade grader, lime applicator and roller.

Crushed stone or slag provides a low quality, low cost surfacing. It requires continuous maintenance and periodic replenishment of the aggregate. Since sprinkling with water is required to prevent dust, its use is not recommended for roads within the community. It would, however, provide an economical surfacing for driveways and parking area.

Drainage in most areas of the Old West Region will not be a problem (low annual rainfall) unless the site of the community is on undulating terrain or has poor soil conditions. Surface water should be directed away from buildings and toward a swale or drainage ditch. It is normal practice to slope drainage areas to ditches located along roads or streets. Drainage channels could also be located in the green areas throughout the community. Corregated metal pipe could be used for culverts due to its low initial cost and its light weight which makes installation and reuse easier than other methods.

SUMMARY

WASTE WATER AND SEWAGE TREATMENT

CONTINUED FROM PREVIOUS PAGE

TABLE V-9B

MANUFACTURER	RELOCATION		TRANSPORT			COST	COMMENTS
	DIS-ASSEMBLY	EX-PERIENCE	HIGHWAY	RAILROAD	RANGE		
AIRCO CYROPLANTS	DIFFICULT	NO	X	X	OPEN	NOT AVAILABLE	∷ AS ADDITION TO EXISTING TANKAGE
AIR-O-GEST SEWAGE	MODERATE	YES	X	X	OPEN	46 TO 56,000$	
AUTOTROL-BIO-SURF	MODERATE	NO	X	X	OPEN	100,000$ WHEN USED W/ FILTER	∷MAY BE USED W/OTHER EQUIPMENT AS NEW SYSTEM OR W/EXISTING FACILITY AND ELIMINATES SLUDGE THICKNERS IN EXISTING SYSTEMS
INTERNATIONAL	SIMPLE	YES	X	X	OPEN	100,000$	∷NEEDS HOLDING TANK 5000 GAL. 668 CU.FT. 9' HIGH 10' DIA.
MET-PRO SYSTEMS	SIMPLE	NO	X	X	OPEN	90,000$	∷SLUDGE HANDLING NEEDED
NEPTUNE MICRO-FLOC	SIMPLE	YES	X	X	OPEN	180 TO 185,000$	∷WILL BE RESPONSIBLE TO A POINT 3 PT. OUTSIDE BUILDING
PRECIPITATOR, INC.	SIMPLE IF STEEL TANKAGE USED	NO	X	X	OPEN	480,000$	∷RESOURCE RECOVERY SYSTEM
SANILOGICAL	SIMPLE	YES	X	X	OPEN	45,000$	∷SYSTEM UNDERGROUND WHICH PERMITS SECONDARY LAND USE
PEMBERTHY & LYCO							∷MAY BE CONTINUED AS A SYSTEM OR INDIVIDUALLY ADDED TO AN EXISTING SYSTEM TO INCREASE OUTPUT

"Each of the following human needs is vital to the mental health, physical well being, and quality of life experienced by every individual in the community.

- Housing
- Health
- Schools
- Transportation
- Employment
- Convenience Shopping
- Utilities
- Local Government
- Fire Protection
- Law Enforcement
- Recreation
- Religion
- Communication
- Social Service"[33]

The provision of human needs above is the basic goal or objective of a community. The adjective (poor, sufficient, good, etc.) used to describe these needs i.e., good housing, good schools, etc., is the overall criteria. Once this objective is determined, then the "possibilities" can be considered and evaluated under specific design criteria and a course of action taken. The "possibilities" can be placed into three general categories: site planning, architecture, and engineering.

The main consideration regarding site planning is cohabitation (man and nature coexisting harmoniously). For example, the site planner should take advantage of the topography to define areas such as private, pedestrian, etc., or designate activity such as sledding or vehicular circulation. A site development plan sympathetic with the site characteristics will result in a more natural environment and lower construction costs.

The main criteria of this report is mobility and the architecture of the community should reflect that concept. Not necessarily in visual appearance but in installation, breakdown, and transport operations. A tent is highly portable, but does it meet the overall design criteria, i.e., good housing.

One of the major problems of the mobile/temporary community is utility installations. When a utility system can be efficiently installed and reused much money can be saved. The initial investment may be higher than conventional applications yet in the long run the system should pay for itself. No utility systems currently manufactured are designed for efficient reuse.

FOOTNOTES

1 Lang, Jon; Burnette, Charles, Moleski, Walter and Vachon, David, Designing For Human Behavior, (Dowden, Hutchinson & Ross, Inc., Stroudsbur, Pa., 1974)

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10 Ibid, p. 112

11 Lynch, Kevin, Site Planning, (M.I.T. Press, Cambridge, Mass. 1963), p. 324

12 McKeever, Ross J., The Community Builders Handbook, (Urban Land Institute, Washington, D.C., 1968)

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20 Acknowledgement is made to Greenway, Donald, University of Texas for data on motel economics

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FINANCE

COST ANALYSIS
COST SUMMARY
FINANCING
FINANCING FACTORS
UNIQUE PROBLEMS
FINANCE RESOURCES
DEVELOPER FINANCE
GOVERNMENT FUNDS
CONCLUSION
FOOTNOTES

This section deals with money. We will establish the amount of investment capital required to develop and operate a hypothetical community. Possible methods of financing community developments will also be discussed.

The following cost analysis was based upon a design for a community of 1,500 people. For a more detailed development of this cost analysis refer to the appendix.

COST ANALYSIS

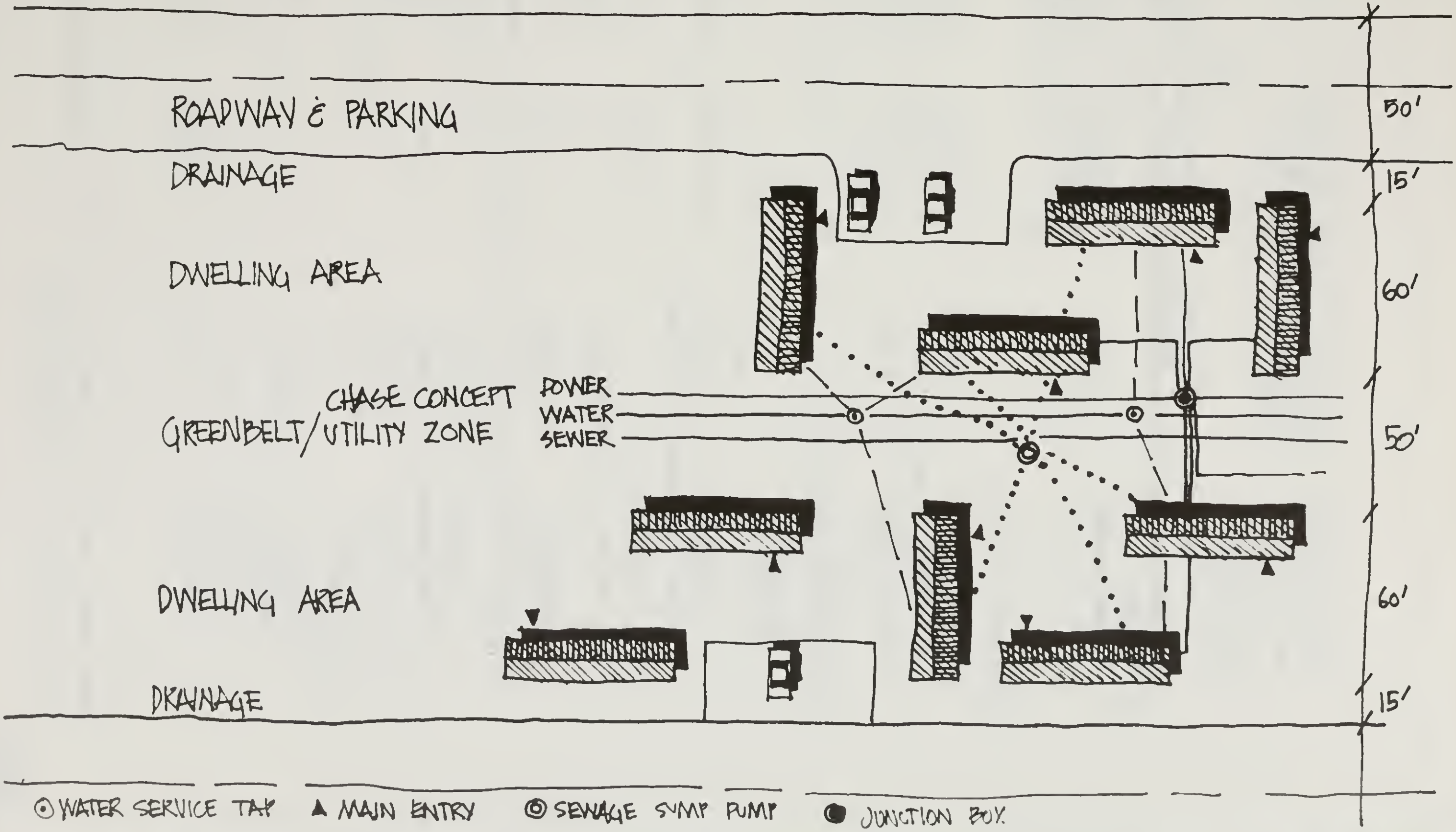
The cost analysis divides community development expenses into three categories: Architecture, (buildings) Engineering, (utilities) and Town Planning (streets, parking lots and parks). Costs are further defined as unreclaimable investments such as labor and permanent installations and reclaimable investments such as mobile homes and other relocatable facilities.

Architectural costs come to a total of 8.4 million dollars and over 90% of this investment can be reclaimed. We will assume the disassembly cost is equal to the initial labor cost so reclaimation of structures will involve 120,000 dollars for disassembly labor. Assuming re-erection labor costs are the same as initial erection labor costs, the total loss from one site to the second site would be less than 10% (depreciation, deterioration and transportation factors not included) of the initial investment for installation and materials. Due to the mobility of mobile homes community architecture could be economically relocated five or more times.

Engineering costs are not as reclaimable as architectural costs. The following engineering estimates are based upon a pressurized sewerage system, a typical P.V.C. water distribution system, and the main electrical distribution runs from poles down to surface transformers with

UTILITY LAYOUT FOR COST ANALYSIS

FIGURE VI-1



COST ANALYSIS*

TABLE VI-1

ARCHITECTURAL	COSTS		
(Structure Types)	Permanent Foundation	Erection Labor	Building/ Materials
(1) HOUSING			
Mobile Homes	None	$50,000 w/tie downs	$6,500,000 w/reuseable foundations & tie downs
(1) COMMERCIAL-RETAIL			
Mall	$56,000	$50,000	$500,000
Restaurant/Lounge	None	$ 600	$143,000
Building Material	$ 3,600	$ 4,000	$ 60,000
(1) COMMERCIAL-SERVICE			
Gas Station			
Sales	None	$ 100	$ 12,000
Garage	$ 900	$ 900	$ 13,500
Concrete Aprons	$ 5,000		
Pumps/Tank		$ 2,000	$ 15,000
Barber/Beauty Salon	None	$ 100	$ 20,000 w/equipment
Laundry	None	$ 100	$ 7,500 w/equipment
Bank	None	$ 100	$ 12,500 w/furnishings
Motel/Apartments	None	$ 4,000	$330,000 w/furnishings
(2) EDUCATION			
Day Care	None	$ 100	$ 16,800
Elementary			
Short Span	None	$ 2,000	$153,235
Long Span	$ 1,520	$ 1,520	$ 24,320

*Based upon a construction work force of 500 and resulting community of 1,500.

(1) Private Costs (2) Public Costs

ARCHITECTURAL

	Permanent Foundation	Erection Labor	Building/ Materials
(2) EDUCATION - CONTINUED			
Secondary			
Short Span	None	$ 1,600	$123,785
Long Span	$ 7,000	$ 1,050	$ 42,000
Maintenance Storage	$ 1,000	$ 1,000	$ 15,000
(2) COMMUNITY			
Fire Station	$ 800	$ 800	$ 12,000
Administration/Police	None	$ 200	$ 30,800
Post Office	None	$ 200	$ 26,400
Maintenance/Treatment	$ 1,000	$ 3,000	$ 45,000
Medical Clinic	None	$ 100	$ 60,000 w/equipment
ARCHITECTURAL SUBTOTAL	$76,820	$123,470	$8,162,840

ENGINEERING	COSTS	
	Installation	Material & Equipment
(2) TREATMENT FACILITIES	$ 2,000	$200,000
(2) SEWER SYSTEM	$350,203	$290,890
(2) WATER SYSTEM	$205,742	$204,108
(2) ELECTRICAL DISTRIBUTION	$224,944	$326,282
ENGINEERING SUBTOTAL	$782,889	$1,021,280

TOWN PLANNING	COSTS Labor and Materials
(2) RECREATION	
Hard Surface-Multi-Use Court	$ 30,000
Tot Lots -8 @ $4,000 Each	$ 32,000
Picnic Shelter	$ 4,000
Horseshoe Court	$ 1,000
(2) EDUCATION	
Hard Surface Areas 31,050	$310,000
(2) LANDSCAPING	
Excavation	
Residential	$ 25,000
Community/Recreation	$ 20,000
Planting	$ 50,000
(2) CIRCULATION	
Roads	
Excavation	$ 25,000
Paving	
Asphalt	$150,000
Oil	$309,000
Walks	
Paving (Concrete)	$120,000
(2) PARKING (GRAVEL)	
Residential	$105,000
Commercial	$ 79,333
Community	$ 11,200
TOWN PLANNING SUBTOTAL	$1,271,533

TOTAL	Unreclaimable Costs (Labor & Permanent Installations)	Reuseable Materials/Structures
	$ 2,254,712	$ 9,184,120

OPERATING COSTS

TABLE VI-2

RESIDENTIAL

Telephone: Source:	84$/year x 500 units Mountain Bell Casper, Wyoming	$ 42,000
Power(Electricity): Source:	480$/year x 500 units Pacific Power & Light Casper, Wyoming Based upon an all electric mobile home	240,000
Subtotal		$282,000

EDUCATION (Source: Harold Whitefoot)

Daycare:	(1) Instructor @ $9000/year (2) Teacher's aids @ $7500/year Utilities $300 Maintenance $200	$ 24,500
Elementary:	(1) Principle/Superintendent @ $20,000/year (1) Secretary @ $8,000/year (1) Janitor @ $9,000/year (6) Instructors @ $11,000/year Utilities $4,000 Maintenance $1,000	108,000
Secondary:	(1) Janitor @ $9,000/year (4) Instructors @ $11,000/year Utilities $2,400 (Modules)/year $10,000 (Air Structure)/yr. Maintenance $1,000/year.	66,400
Subtotal		$198,900

CULTURAL

Library:	(1) Librarian @ $12,000/year (1) Assistant @ $7,000/year Maintenance and Utilities - Time-Shared	$ 19,000
Museum:	(1) Curator @ $12,000/year (1) Assistant @ $7,000/year	19,000
Subtotal		$38,000

COMMERCIAL

Mall: Restaurant/Lounge:
Gross Income ($179,200)
Salary as % of Gross Income (37.2)
Salaries $66,662

Grocery: G.I. ($822,000) % G.I. (9.5)
Salaries $78,090

General Merchandise:
G.I. ($520,000) % G.I. (20.8)
Salaries $108,160

Clothing: G.I. ($260,000) % G.I. (19.1)
Salaries $49,660

Furniture: G.I. ($215,000) % G.I. (15.2)
Salaries $32,680

Auto Supplies: G.I. ($825,000) % G.I. (18.2)
Salaries $150,150

Drugs: G.I. ($175,000) % G.I. (10.1)
Salaries $17,675

Mall: Utilities & Maintenance $50,000
(Air Structure)
Source: Bird Air Structure Inc.

Subtotal $448,740

Restaurant/Lounge: 2400 S.F.
Gross Income ($98,000)
Salary as % of Gross Income (37.2)
Salaries $36,456
Maintenance/Utilities as % of Gross Income (6.3)
Maintenance/Utilities $2,300

Lounge: 1400 S.F.
G.I. ($57,300) % G.I. (37.2)
Salaries $21,315
% M/U (6.3) M/U $1,350

Gas Station:
G.I. ($475,000) % G.I. (18.2)
Salaries $86,450
% M/U (.7) M/U $6,052

Motel/Apartments: 60 Units
G.I. ($241,000 w/ 71% occupancy)
% G.I. (21.7)
Salaries $52,297
% M/U (6.3) M/U $3,295

Building Materials:
G.I. ($345,000) % G.I. (18.9)
Salaries $65,205
% M/U (1.2) M/U $783

Fast Food Restaurant: 1600 S.F.
G.I. ($65,000) % G.I. (37.2)
Salaries $24,366
% M/U (6.3) M/U $1,535

Barber/Beauty Salon: 800 S.F.
(4) Employees @ $44,000
Maintenance & Utilities $1,000

Laundry: 800 S.F.
(1) Employee @ $10,000
Maintenance & Utilities $3,000

Bank: 800 S.F.
(2) Employees @ $25,000
Maintenance & Utilities $500

Subtotal $384,894

COMMUNITY

Clinic: (1) Registered Nurse @ $11,000
(1) General Practioner (1 Day/wk)
@ $25,000
Source: Natrona County Memorial
Hospital, Casper, Wy.
Utilities & Maintenance $2,300

Fire Protection: Utilities & Maintenance $500

Police: (2) Field Officers @ $19,200
(1) Chief @ $17,000
(2) Secretary/Dispatcher @ $16,000
Source: City of Casper
Utilities & Maintenance $600

Government: (1) Administrator @ $10,000
(1) Secretary @ $8,000
Utilities & Maintenance $500

Post Office: Operated by Federal Government

Recreation: (1) Director @ $12,000
Operating Cost $2,000

Water Treatment & Sewage Treatment: (.5 MGPD)
(1) Operator @ $12,000
Chemical & Utilities $1,500

Solid Waste Disposal: (1) Operator @ $12,000
(2) Collectors @ $20,000
Operating Cost $1,000

Subtotal $191,300

SUMMARY:

Residential:	$282,000
Education	198,900
Cultural	38,000
Commercial:	
Mall	448,740
Other	384,894
Community:	191,300
Total Operating Cost	$1,543,834

underground service lines radiating from below grade junction boxes. The engineering costs come to about 1.8 million dollars of which 43% is labor. Assuming re-excavation and disassembly would cost 86% of the initial engineering investment (labor and materials) to relocate the infrastructure and if transportation and deterioration are considered, relocation of used materials approaches 100% of the initial investment which is the same as a completely new installation. Above ground elements such as treatment facilities and electrical equipment could still be reused with reasonable economy. However, the original community site would still retain a grid-work of distribution lines and anticipated higher material costs make infrastructure relocation more attractive.

Town planning elements are essentially permanent and reuse is impractical. Some recreation equipment could be salvaged but in relation to the overall town planning investment, recreational equipment costs are minimal. We will assume the 1.3 million dollar investment is virtually unreclaimable.

The overall cost of the community is 11.4 million dollars. The unreclaimable costs are approximately 19% of the total investment. The expense involved in disassembling the community for relocation would be approximately one million dollars. The reclaimable material investment comes to a total of 9.2 million dollars. The total loss from initial installation through one relocation is 3.1 million dollars. The relocation factor appears to be three (three moves). The major element determining the relocation factor is the mobile homes (they are highly portable and represent 50% of the total community investment).

COST SUMMARY

In summary the relocation of the architecture of the community is relatively efficient, especially mobile homes. Town planning expenses are virtually unreclaimable because earthmoving is physical work and not an object to be moved from site to site. Engineering costs are not highly reclaimable due to the large amount of labor involved in installation and disassembly. The portable piping system discussed in previous section was not utilized in this hypothetical cost analysis. More savings would have probably been recognized, but since it is a relatively unique and new method figures would not have been very accurate.

FINANCING

The sources and methods, along with the problems and constraints, related to front-end financing of mobile community facilities described in this report are in many ways similar to those related to the financing of permanent facilities which in many ways reduces the number of alternatives and places further limitations on front-end financing of the kinds of community services described.

The purpose of this sub-section is to (a) describe the major variables which affect financing alternatives along with the problems or constraints which have made front-end financing for community facilities difficult, (b) identify additional financing problems related to the unique nature of mobile facilities, (c) describe the financing alternatives which appear to provide the most realistic means of front-end financing for the kinds of community facilities identified in this study.

There are a variety of circumstances and variables which will dictate the source and method of providing front-end financing for community facilities. Examples of variables include but are not limited to the following:

- o Is the community new or will facilities supplement an existing community?
- o Will the impact be caused by one company or more than one?
- o What type and quantity of facility will be required in a given instance?
- o Is there an existing tax base within the community?
- o What is the cost of each individual facility and what is the total for all facilities?

- If facilities will be added to an existing community, are there planners and personnel available within the community to assume financial planning responsibility?
- What magnitude is the population impact?
- What is the financial health of the existing community, county or the developing company?
- What are the state laws regarding financing authorities, taxes, joint powers authority, etc.
- Are there major tax imbalances within the state?

FINANCING FACTORS

To discuss each of the variables above or combinations thereof and describe how each affects financing decisions would be academic and serve no immediate purpose. However, there are some factors which obviously have a major impact on what base financing may occur. Following is a discussion of some of these more critical factors.

Whether the development entity will provide direct or indirect financial assistance or take the lead in organizing community facilities, mobile or permanent, will depend considerably on what the nature of the impact is (i.e., in terms of dollar requirements, population, association with other development companies, etc.) and the type and size of the community affected (new community, existing small community).

A second major consideration is the capability of governmental entities to provide funds to impact areas. For example, one significant problem in many states has been tax imbalances causing a misdistribution of funds among local governmental entities in communities suffering from impact. As one source put it "mineral development is usually in the county. The counties and school districts get the tax base and the cities get the impact."[1] Even with adequate tax bases, these revenues normally arrive only after mineral production has begun. Thus there is a significant timing problem between when funds are needed for community facilities construction and when the impacted city receives funds. Because of the timing and uncertainty of revenue to be generated, any type of debt financing by the impacted community is often costly or nonexistent.

Many states have instituted a variety of means to assist impacted areas, such as the development of special financing authorities capable of floating tax exempt bonds, purchasing local issues where no other market exists or lending money to impacted communities with the development entity assisting the community in guaranteeing debt retirement. Our review indicates a trend toward the kind of legislation recently passed in Wyoming which is geared toward providing relief to energy impacted communities and the distribution of energy taxes to energy intense areas.

A third major problem which has limited financing alternatives for front-end funds has been the uncertainty as to when, if or to what extent construction will take place. These uncertainties may result from a variety of causes such as the need for approvals from higher government, delays in courts or the introduction of new legislation. As a result, planners either in industry or government are often unsure not only as to what facilities will be needed but when the facilities will be required. The use of mobile facilities may somewhat reduce uncertainty as reaction time and financial requirements may be less of a burden than permanent facilities. Nevertheless, neither government nor private industry has been willing to commit front-end money for any facilities until uncertainties are eliminated--and when this occurs, there may still be unavoidable time delays for both the facilities and the funds needed to finance them.

The problem of uncertainty is often compounded by the lack of planning and financial expertise within potentially impacted small communities. City councils in these communities may not be paid or may receive as little as $10 to $20 per meeting. Typically they have limited planning funds to review and analyze the degree of impact or the financial alternatives available.

UNIQUE PROBLEMS

In addition to the previously described problems and constraints related to financing, there are also unique problems resulting from the lack of permanency of temporary communities.

One problem which may arise revolves around the question of ownership. An advantage of mobile facilities would be the ease of movement of these facilities from one location to another. If the developer owns all or part of the facilities, the assumption would be that this company could use these facilities on another site when needed. This might be logical if the company were planning additional development and this development coincided with the availability of unused and unneeded mobile facilities at previous community sites. However, if this were not the case, unique problems may arise from unused inventory of facilities or the untimely removal of needed facilities from the original site. This potential problem could limit the attractiveness for a company to finance such facilities. If a political subdivision (state, county, school district, utility district, or city) financed and owned the facilities, a similar problem arises from what to do with abandoned facilities after peak impact. If a county and city, through a joint powers agreement, financed all or part of the facilities, these facilities could be used in the same county at other energy development sites. However, in this case, there is again a problem of availability coinciding with need and the communication and coordination needed between local government and the companies who may wish to either get rid of or relocate these facilities.

A second unique financing problem related to the lack of permanency of the facilities would be the definition of the facility as a means of securing debt. In many cases, financing is provided either privately or through public markets because of the dedication of the revenues generated by the facility to the retirement of the debt. Because mobile community facilities would not be intended to be permanent structures, the nature of security might be questioned and the availability of long-term financing at reasonable costs may be limited.

FINANCE SOURCES

In addition to the normal financial institutions and private investors used in most cases to finance commercial facilities, there are a number of financing sources for both capital and operating funds to support community facilities such as those described in this report.

A recent study by a subcommittee to the Colorado Governor's Committee on Oil Shale Environmental Problems reviewed alternative revenue sources for local governments and potential techniques for handling revenue timing and distribution problems. The study, "Tax Lead Time Study", was published in 1974 and is available through the Colorado Geological Survey, Department of Natural Resources, State of Colorado.

Although the study relates more to permanent facilities and was prepared for Colorado, because of the similarities between permanent and mobile facilities and between the Colorado problems and the States within the Old West Commission boundaries, we have included several references from that study. One such reference of particular relevancy is the chart described as Urban Services included as Table VI-3 although defined more for permanent type facilities, this schedule should provide the reader with a general reference as to the relative magnitude of capital and operating costs, capital and operating financing alternatives, service expenses, lead time expansion requirements and usual priorities for action regarding a variety of urban services, regardless whether they are permanent or mobile facilities. For further analysis, we highly recommend that a copy of this report be obtained by either private industry or governments planning on the development of temporary/mobile communities.

As was stated earlier in this section, although the problems and constraints regarding the front-end financing of community mobile facilities are similar to those related to permanent facilities, there are some unique added problems which may further limit the alternatives available.

To avoid removing any financing alternatives we have included another schedule from the "Tax Lead Time Study" summarizing various "Non-Monetary Fiscal Devices" available for Colorado local governments to provide front-end financing for community services (Table VI-4). The similarities of the Old West Region and their impact problems allow the reader to obtain

URBAN SERVICES

SOURCE: OIL SHALE TAX LEAD TIME STUDY
KEYS: CAPITAL COST (C) OPERATING COST (O)

TABLE VI-3A

	URBAN SERVICES	CAPITAL COSTS FOR FACILITIES			ANNUAL OPERATING COSTS		FINANCING ALTERNATIVES										
		HIGH	MODERATE	LOW	HIGH	MODERATE	GENERAL TAX REVENUES	INTERGOVERNMENTAL REVENUES	SPECIAL IMPROVEMENT DISTRICTS	CENTRAL IMPROVEMENT DISTRICTS	DEVELOPER CONTRIBUTION	NON-PROFIT CORPORATION	USER FEES	PRIVATE UTILITIES	GEN. OBLIGATION BONDS	REVENUE BONDS	LEASING
	SCHOOLS	X			X		O	C,O			C	C			C		C
	POLICE		X		X		O	C,O			C	C			C		C
	FIRE	X			X		O	C			C	C	O		C		C
	HOSPITAL	X			X		O	C,O		C		C,O	C,O	C,O	C	C	C
	HEALTH SERVICE		X		X		O	C				C,O	C,O	C,O		C	C
	AMBULANCE		X			X	O	C					C,O	C,O			C
TRANSPORTATION	COUNTY ROADS		X			X	C,O	C,O	C		C				C	C	
	CITY STREETS:																
	LOCAL			X		X	C,O	C	C	C	C				C		
	MAJOR ROUTE	X			X		C,O	C,O	C	C	C				C		
	PUBLIC TRANSIT	X			X		C,O	C,O				C	C,O	C,O	C	C	C
	AIRPORT	X				X	C,O	C,O				C	C,O		C	C	
UTILITIES	ELECTRICITY	X			X		C,O	C			C	C	C,O	C,O	C	C	
	GAS	X				X	C,O	C			C	C	C,O	C,O	C	C	
	TELEPHONE	X				X						C	C,O	C,O	C	C	
	WATER	X			X		C,O	C	C	C,O	C	C	C,O	C,O	C	C	
	SEWER	X			X		C,O	C	C	C,O	C	C	C,O	C,O	C	C	
FLOOD	MAJOR TRIBUTARIES	X				X	C,O	C	C	C,O	C	C	C,O		C	C	
	LOCAL DRAINAGE			X			C,O	C	C	C,O	C	C	C,O		C	C	
SOLID WASTE	COLLECTION			X		X	C,O	C				C	C,O	C,O	C	C	C
	DISPOSAL		X			X	C,O	C				C	C,O	C,O	C	C	C
PARKS	NEIGHBORHOOD			X		X	C,O	C		C	C				C		
	COMMUNITY		X			X	C,O	C		C	C				C		
	RECREATION		X			X	C,O	C		C	C	C	C,O	C,O	C	C	C
	HOUSING	X				X	C,O	C,O				C	C,O	C	C	C	C
	HUMAN RESOURCES			X	X		C,O	C,O									
	GEN. ADMINISTRATION		X		X		C,O	C,O									
	CULTURAL FACILITIES		X			X	C,O	C		C		C	C,O	C,O	C	C	C
	GOVERNMENT BLDGS.	X				X	C,O	C			C						C

a general concept of what may be available as financing alternatives for community facilities.

From a practical standpoint, because of the mobile nature of the facility, the alternatives defined on Table VI-4 may be reduced to fewer financing mechanisms. The following paragraphs describe those alternatives which may best lend themselves to mobile communities.

It is generally believed that development companies should participate in the financing of community facilities, particularly in a situation where one company is the major cause of impact on a small community and the majority of users of facilities are the company employees and their families. The benefits during the construction period obviously accrue primarily to the development company. The more satisfactory the living environment is around the construction site, the lesser the problems; the greater the economy and efficiency of the development process.

In the case of permanent public facilities required as a result of the influx of first construction and later permanent workers, it is generally believed that considerable responsibility for planning and constructing public type facilities lies with local and county government although some financial assistance may be assumed by the developer. This may be particularly true where more than one company is involved in the growth of a community and the community already contains a government structure equipped to identify the impact problems and plan and finance needed facilities.

DEVELOPER FINANCE

In the case of mobile community facilities where the situation calls for a basically new community with no existing facilities or government, the developing company in most cases must take the lead.

There are a variety of methods which the developing company may use to assist with financing.

URBAN SERVICES

(CONTINUED) *KEY: (1) PLAN & DESIGN IMMEDIATELY (2) PLAN BUT START WHEN PEOPLE ARRIVE (3) PLAN BUT DETAIL & DEVELOPE AFTER PEOPLE ARRIVE

TABLE VI-3B

URBAN SERVICES	FISCAL SHORT-FALL CHARACTERISTICS		SERVICE SPONSOR						NON-LOCAL FUNDING OPPORTUNITIES		LEAD TIME EXPANSION REQUIREMENTS		SELF-SUSTAINING POTENTIAL		PRIORITIES FOR ACTION*
	HIGH	LOW	CITY	COUNTY	STATE	FEDERAL	DISTRICT	PRIVATE	CAPITAL	OPERATIONS	PLANNING	OPERATIONS	CAPITAL	OPERATIONS	
SCHOOLS	x						x	x		x	12 mo.	6-18 mo.			2
POLICE		x	x	x					x		6-12 mo.	6 mo.			2
FIRE		x	x				x				6-12 mo.	6-12 mo.			2
HOSPITAL		x	x	x			x	x	x		12-18 mo	12-24 mo		x	3
HEALTH SERVICE		x	x	x			x	x		x	6-12 mo.	6 mo.		x	2
AMBULANCE		x	x	x			x	x			6 mo.	3 mo.		x	3
COUNTY ROADS	x			x						x	6 mo.	6 mo.			2
CITY STREETS:															
LOCAL	x		x						x	x	3 mo.	6 mo.	x		2
MAJOR ROUTE	x		x						x	x	6 mo.	12 mo.			1
PUBLIC TRANSIT	x		x	x			x	x	x		6 mo.	6 mo.			2
AIRPORT	x		x	x					x	x	6-12 mo.	12 mo.		x	3
ELECTRICITY	x		x					x	x	x	6-12 mo.	6 mo.	x	x	2
GAS	x		x					x	x	x	6-12 mo.	6 mo.	x	x	2
TELEPHONE	x							x	x	x	6-12 mo.	6 mo.	x	x	2
WATER	x		x				x	x	x		12 mo.	6-12 mo.	x	x	1
SEWER	x		x				x		x		12 mo.	6-12 mo.	x	x	1
MAJOR TRIBUTARIES	x		x	x	x	x	x		x		12 mo.	12 mo.	x		2
LOCAL DRAINAGE		x	x	x					x		3 mo.	6 mo.	x		3
COLLECTION		x	x	x				x	x		3-6 mo.	3-6 mo.	x	x	3
DISPOSAL		x	x	x				x	x		6 mo.	3-6 mo.	x	x	2
NEIGHBORHOOD		x	x				x		x		3-6 mo.	3-6 mo.	x		3
COMMUNITY		x	x	x			x		x		6 mo.	6-12 mo.			3
RECREATION		x	x	x	x	x	x	x			6 mo.	3-12 mo.		x	3
HOUSING	x		x	x				x	x	x	12-18 mo	12 mo.			1
HUMAN RESOURCES		x	x	x	x					x		3-6 mo.			3
GEN. ADMINISTRATION	x		x	x						x		3-6 mo.			1
CULTURAL FACILITIES		x	x	x				x			6-12 mo.	12 mo.		x	3
GOVERNMENT BLDGS.		x	x	x							6-12 mo.	-			3

- Industry Financed Facilities

  "Under this concept industry would assume total financial responsibility for the facilities. Examples of this approach are (1) companies providing basic utilities and/or housing for their workers; (2) subdivision developers providing a cottage school until permanent facilities are available; and (3) complete new towns built by a company constructing the facility, retains ownership and rents on a non-profit basis. In other cases, the company undertakes construction and then leases the facilities to a local government. Company towns have a long history ranging from military installations with total living environments to the coal mining towns of Appalachia and the "new" towns of the TVA.

  Where local communities were non-existent or incapable of meeting the demands of an instant major new employment center, companies have been compelled to meet their workers' needs for community facilities and housing. Tax incentives for the industry providing such facilities can be a positive factor. Otherwise, industrial completion may discourage such actions."[2]

- Purchase of Short-Term Paper

  The use of long-term financing such as long-term bonds, is probably not a viable financing method for mobile facilities. Since money will be needed quickly by the community to provide necessary facilities, interim financing through short-term duration promissory notes may be an answer. In this instance, the local government would issue the notes and the company would be the buyer. "The local government would gain the time it needs to achieve a better financial position and the company would be obligating itself for a short period of time, likely three to five years."[3]

  This mechanism may be useful in a county where mobile facilities may be relocated within the county. The county issues the notes in conjunction with a small local government. The government then has ownership of the facilities and can control the movement

NON-MONETARY FISCAL DEVICES

TABLE VI-4A

	GENERAL OBLIGATION BONDS	REVENUE BONDS	SPECIAL ASSESSMENT BONDS	INDUSTRIAL DEVELOPEMENT BONDS	REFUNDING BONDS
DESCRIPTION	Bonds backed by the full faith and credit of the issuing agency. Insurers promise to levy additional property tax to retire debt if necessary. Promise to pay is contractual and unrestricted. These are lowest interest rate bonds.	Bonds issued without backing of full faith and credit of the issuing agency. Bonds usually retired from revenues generated by the project, financed, or more broadly, from revenues from specified sources other than general fund.	Special assessment bonds are issued to pay for public improvements where specific private benefits exist. Payments from private individuals retire the bonds on the basis of benefit conferred.	Also called county and municipality development revenue bonds. Issued to aid industry in financing capital costs. Government incurs no debt, bonds retired by payment from industry. Bonds are tax exempt.	Bonds that are issued to change the form of outstanding debt, to achieve certain advantages. Any type of bond can be refunded.
PURPOSE	Used by local government to finance capital projects when it is felt that the project should be paid for by the entire public, spread over a long period of time.	Originally conceived to provide front-end financing for facilities that could pay for themselves. Recent applications permit use where self retirement of debt from the project is impossible, but pledge of other revenues permits utilization.	To enable property owners to amortize over a moderate period of years, at low interest rate, the capital costs associated with constructing various public facilities, i.e., streets, storm drainage, water or sewer.	Must serve a public purpose whether it be attraction of industry to stimulate economic growth or the provision of services in furtherance of the public health or welfare.	Generally, to shorten term of issue, achieve more favorable interest rate, eliminate restrictive covenants of base issue, reorganize the maturity pattern or to consolidate debt.
LEGALITY	The state constitution requires that local govenment general obligation debt (1) be for a public purpose, (2) except by a home rule charter approved by the electorate, and (3) fall within statutory debt limitations. Debt contracted for the purpose of supplying water is also expected.	Only applicable constitutional requirement is that the debt be issued for a public purpose. Except as provided by home rule charter, no debt limitation or voter approval requirements.	Specific statutory authority exists to permit cities, town, and counties to create special assessment districts, sometimes called local improvement districts, that may borrow by issuing special assessment bonds.	These avoid the Colorado constitutional requirement that prohibits lending of public funds to person, company, or corporation. Statute does not require election.	Generally, any bond that can be legally issued can also be legally funded. Debt limitations are not additive and, therefore, are not a factor.
CITIZEN OR POLITICAL ACCEPTANCE	Due to election requirements, citizens' right to approve or reject is positive and direct on each issue.	Since facility user fees are the principal means of debt retirement, most citizen concern comes from users of facilities and how much they will pay.	Citizens who want a certain public improvement that will result in a direct and specific benefit often use this approach. Most districts are not created without majority consent by the benefitting and, therefore, paying property owners.	Citizen understanding is often a problem. Feeling that issuance of bonds is a public subsidy to private purpose is common. Full public disclosure of total program is necessary.	Citizen understanding and a clear public purpose are probably the keys to acceptance.
ADVANTAGES	Gives local governments the best possible terms. Retired from ad valorem taxation over life of issue. A hedge against inflation. Projects can be financed which do not generate revenue.	No debt limitations. Default in issue does not burden local tax payers. Voter approval not always necessary. Concept of user pays is popular.	Requires little or no capital from the issuing agency. Does not ordinarily affect community debt limits. Formal election is not required. Citizen involvement tends to shape the project into a publicly acceptable form.	May permit small industrial developments to site where private financing might preclude it. Bonds are not subject to public debt limitations. Debt retirement is by the industry, not the public. Serves as a planning tool for local governments.	Offers opportunities for flexibility to modifying community debt structure. No election required Issuance costs are low. Net dollar gain can accrue to issuing agency.
DISADVANTAGES	Lay time obtaining funds can be very costly. Community debt limitations could restrain logical usage. Costs are not necessarily paid for by the project beneficiaries. Can only be used for certain purposes in counties.	Typically higher interest rates than for general obligation bonds. Exposure to litigation is greater than for voter-approved general obligation bonds. Use may be limited to revenue-generating projects.	Special assessment bonds demand interest rates higher than general obligation bonds. Never 100% citizen support. Administrative costs can be high percentage of small project costs. Flexibility of bond issue may be significantly limited by statutes.	Need for private companies to deal with public inhibits some applications. Size and application limits use. Local government hesitate to use because of political and credit standing problems. Interest rates generally highest of all tax-exempt bonds.	Some administrative costs do occur. Therefore, savings must be significant enough to offset this loss.

of those facilities as the need arises.

- Third-Party Leasing

  One particularly realistic method to finance mobile facilities would be through a third-party leasing arrangement. Under this method an "industry would contract a leasing corporation or a specially created non-profit corporation to supply a facility or equipment needed by the local government. The liability would belong to the industry. The local government could enforce the contract against the lessor in its own right."[4]

- Prepayment of Taxes

  One means often suggested for front-end financing is for the developing company to prepay taxes voluntarily based on some anticipated tax burden. "One possible way that such a program could be formulated would be to project the likely tax burden of an industry for a period of time into the future, such as ten years. The total figure of anticipated taxes would probably be projected for only seven or eight of those ten years if operations were imminent on year one -- reflecting the two to three year property tax lag. However, if that total amount of taxes was to be divided by ten, that fraction could be paid at year one and each succeeding year and the same amount of taxes would be paid by year ten. Deviation of actual taxes from projected taxes could be corrected periodically."[5]

  There is an opposing view often taken by industry because prepayment of taxes has penalties attached.

  Taxes can be claimed on federal income tax returns in the year they are due. Prepayment of taxes is non-allowable for deduction under existing Federal and State laws, therefore, the company would have to come up with cash now and wait a number of years to claim the tax benefit.

  As one energy company put it "Federal tax consequences apply to all kinds of corporations and should be taken into consideration

NON-MONETARY FISCAL DEVICES

TABLE VI-4B

LEASING/ INSTALLMENT PURCHASE	NON-PROFIT CORPORATION	SPECIAL DISTRICTS	REGIONAL SERVICE AUTHORITIES	REGIONAL REVENUE DISTRIBUTION	
A technique by which local government can acquire equipment or public facilities immediately without the capital funds necessary for outright purchase. Lessor is a private leasing firm or a non-profit corporation.	A relatively new and flexible concept. A non-profit corporation may issue tax-exempt bonds for the purpose of creating public facilities that will eventually become the property of sponsoring public agency when the bonds are paid.	These quasi-municipal units take several forms. Most are created to deliver a single urban service; e.g., water, sewer, parks. They are governed by a Board of Directors either governmentally appointed or elected by direct vote.	Political subdivisions of the state formed to meet numerous service needs on a regional basis--recently authorized by state legislation. Requires at least two counties. None exist at present. Created by and limited to services approved by the voters.	Sharing part or all property and other taxes throughout the region regardless of location of tax generator.	DESCRIPTION
Generally used by local governments facing substantial capital outlays who choose (for various reasons) not to pursue traditional forms of debt financing. Can be used to avoid debt limitation requirements.	To provide public facilities for a governmental agency with tax exempt bonds without creating any debt for the agency benefitted.	Purpose is to deliver an urban service that is not being delivered or cannot be delivered by existing general government agencies.	Legislative purpose is to utilize single service authorities in providing multi-function services and facilities across local government boundaries to reduce duplication, proliferation, and fragmentation of some urban services.	To encourage regional unity and avoid competition. To permit the area to share in the benefits of commercial and industrial growth as well as to deal jointly with complex problems of growth without competing for tax base.	PURPOSE
Legal problems exist, care in usage is necessary. Most local governments have the power to lease. Generally, they must (1) only be bound for 1 year, (2) make rental payment out of yearly revenues, (3) be able to "walk away" at the end of any yearly period.	Use of non-profit corporations as a financing device requires careful attention to legality in Colorado. It is possible that in certain applications, the non-profit corporation acts as an agent in acquiring debt on behalf of the local government.	Special districts are creatures of the state and their powers and creation are provided by express state legislations. County approval of special district creation is necessary.	Constitutional amendment passed in 1970 provides authority. Enabling legislation was passed in 1972.	New legislation would be needed in Colorado. Limitations would be subject to the enabling Act.	LEGALITY
Generally, leasing does not seem to attract much public attention. Leasing may be particularly acceptable in a situation where standard forms of debt-backed purchases are turned down by the voters.	Since there has been little use made of the concept, public reaction is not well established. Concern could arise in the areas of (1) evading governmental debt limitations and (2) no election.	Formations are usually lightly noted by the citizenry at time of creation. Landowners see them as a way to permit more intensive use of their land. Conflicts with broad urban service programs and goals often occur later.	Substantial citizen concern that RSAs may dilute power of local government. Concept is sound, but citizens have reservations about its workability.	Substantial controversy could be expected. Those with the bulk of the anticipated tax base under present circumstances likely will be reluctant to share the revenue source.	CITIZEN OR POLITICAL ACCEPTANCE
Impact on community debt limitations can be avoided if properly structured. No vote required. Lease can be custom tailered to specific need. Lessee may still acquire title to facility at end of lease period. Facilities may be acquired faster than with use of debt financing.	Could provide financing for projects otherwise not financible. Permits use of tax-exempt funds. Protects the debt capacity of the public body. Public body control over the entity is adequate to assure achievement of public purpose. Generally affords much greater degree of flexibility in financing public facilities.	Circumvents problems dealing with political boundaries. Economics of scale can be achieved. Broad geographic view of service need is possible. Relatively easy to create. Can function expeditiously if managed properly.	Broad view of a specific service is possible. Economics of scale. Circumvention of local boundary problem. Regional tax would create large revenue base. Politically responsive system. Planning for coordination and efficient development of physical, social, and economical elements are required.	Regional distribution of monies without an additional layer of government. Funds could flow to population impact points. Maintains the existing fundamental tax structure. Regional solutions to regional problems.	ADVANTAGES
Interest rates are usually high. Lack of clear definition still clouds some potential applications. Limit to an annual lease is a problem. Implicit interest costs in some installment purchase agreements do not reflect tax exemptions of interest payments.	Time requirement to set up project is significant. Conservative local governments may be reluctant to get involved with such new concepts. IRS ruling of tax exempt status on bonds may not always be easy to obtain if public purpose is not clear and simple. Requires significant guidance from fiscal advisor.	Can dilute the powers of local general governments. Not always politically responsive to public. Optimization of a single urban service may be counterproductive to optimizing a broad spectrum of urban services and goals. Seldom responsive to comprehensive planning efforts of local government.	Viewed as another level of government. May conflict, with local government in broad urban service priority exercises. Regional planning requirement may not be supported locally.	Formula for distribution could cause controversy. Affluent counties would be "giving up" funds to their less fortunate neighbors. Erosion of one more power of local government for those desiring local autonomy.	DISADVANTAGES

by legislators as they establish state taxes. Ultimately, the tax revenue available to the state from any industry - if it is to avoid being punitive or damaging to that industry - must take into consideration these federal tax effects."[6]

- Purchase or Securing of Bonds

  In a situation where the mobile community facilities will be developed as a new community in a relatively small urban area, the use of tax exempt bonds for financing purposes by a governmental entity is slight. Lack of permanency of the facilities provides little security to prospective bond buyers. However in a situation where bonds may be an alternative, except for lack of marketability "an industry might aid local government by providing a market for local bond issues which might otherwise not be readily marketable. Additionally, a lower interest rate should be realized. This technique was used in Nevada in the early 1950's. Anaconda opened a mine in a rural area of the state, placing a burden upon the local school district. When bonds were issued for the construction of a new high school, the company bought most of the issue."[7]

  Another method for industry to assist with bond issues would be for that industry to secure the local government bonds. This would have the effect of lowering the interest rates as well as potentially expanding the marketability.

  An argument against the company securing debt is that it will have an effect on the company's additional borrowing capacity. Lending institutions may consider it a liability even though there would only be a slight chance of payment being required by the company.

  "Corporation credit ratings are based upon their liability-to-equity rates. The very least that would occur from loan guarantees is a higher interest rate to the corporation and corporate rates are already much higher than the rate for public borrowing secured through taxes. In addition, this could be a severe

NON-MONETARY FISCAL DEVICES

TABLE VI-4C

	LOCAL IMPROVEMENT DISTRICTS	GENERAL IMPROVEMENT DISTRICTS	INTER-GOVERNMENTAL AGREEMENTS	INDUSTRY ASSISTANCE TO LOCAL GOVERNMENTS
DESCRIPTION	A device by which people in cities and counties can provide certain public improvements in the vicinity of their properties by assessing themselves, via their government for the improvement costs. It is common for local improvement districts to borrow by issuing special assessment bonds.	A quasi-municipal entity with taxation and borrowing powers created by a city or town to carry out some public purpose. Governing body of the district is the City Council. Substantial involvement of taxpayers within the district is required. Debt of the district is not civic debt.	Contracts among various levels of government to provide certain urban services or to cooperatively purchase an urban service. One agency or private corporation can provide the service for two or more agencies on some fee basis.	Techniques whereby industry assists local government in delivering urban services, i.e., industry built or financed facilities, purchase of bonds, purchase of short-term paper, third-party leasing, prepayment of taxes.
PURPOSE	To provide a device by which public improvements benefitting specific private properties can be made without significant governmental expenditures. Private lands are assessed according to benefits received. Less than 100% of project costs can usually be assessed.	To create a quasi-municipal agency which permits taxpayers in certain areas to create certain public improvements without payment from the city. Payments from the tax-payers within the district or revenues from facilities created by the district may support tax-exempt borrowing.	To permit local government agencies to cooperatively use their powers to effectively deliver and finance urban services. Supports the concept of cooperation between agencies rather than reorganization of political boundaries and entities.	To assist local government in providing needed facilities and services when it is unable or unwilling to provide them on its own. Basic purpose is to eliminate imbalances between service demands and local governmental resources.
LEGALITY	Use in cities has a long history--legality not a question as long as proper procedures are followed and the specific benefit test is met. Use in counties is relatively new; some problems with bond issues.	Statutes permitting creation of these districts are reasonably long standing and application to parking-related projects should cause few problems. Liberal interpretation of what constitutes a public purpose facility under this district could create untested situations.	Enabling legislation is very broad as to powers of local government. This concept lets two or more local governments contractually share those powers including taxation. A broad but underutilized Act.	Legality problem for local government except for due payment of taxes which raises many questions.
CITIZEN OR POLITICAL ACCEPTANCE	Generally accepted when the facilities built clearly deliver a special benefit. Controversies often occur. Benefits may not always be as direct and positive as some citizens would like.	Should be generally positive if the public purpose facility planned is agreeable to the public. Sufficient tax-payer involvement is required during the procedures setting up the district to gain citizen approval.	Should be highly acceptable. No new government is created. Existing systems are reinforced.	Most techniques would elicit positive reaction from local community. Generally, most forms of assistance will be viewed as a commitment to industry stability in the community.
ADVANTAGES	Provisions for public facilities without general fund tax dollars. Public involvement in "thier" project is usually good. Projects lacking public support usually do not get built.	A vehicle to create public improvements when other alternatives may not exist. The ad valorem taxing power vested in the district provides sound financial backing. The legislative body of the city is directly involved to assure continuity with city programs. No city funds need be spent.	No new government is created. Economies of scale. Existing government system is reinforced. Taxing district power gives broad revenue base. Political boundary problems can be avoided.	Facilities and services become possible that might not exist otherwise. Front-end monies from the community are not required. Industry commitments to assist local government tend to spell stability and a positive outlook for the future.
DISADVANTAGES	Administrative requirements are substantial and add to the cost. Lapsed time on a project is usually longer than standard government funded project. Assesses some people who don't want or can't afford the project.	District creation is generally accompanied by administrative red tape. City government must give time and energy to the district even if no city monies are involved. Although the debt incurred is not a responsibility of the city, those who are encumbered to assure payment are less free to support other city projects.	Multi-agency agreements for services could cause conflicts when trade-offs are required with other urban services. Regional plan achievement might become more difficult. Competitive forces between local agencies could limit cooperation.	People who make voluntary contributions tend to attach restrictions to the "gifts." A company town could be competitive with existing centers. Places demands on industry and resources not directly related to production or profit.

> burden on medium-sized and small corporations and could even cause them to cancel projects."[8]

Besides the industry assistance program, Table VI-4 summarizes a variety of financing methods available to local and state government. Also, there are governmental discretionary type funds taking the form of grants and loans. Some of these require matching funds or services in lieu thereof; others require simply an application to a qualified governmental agency. In addition, there are a variety of federal programs providing funding through various U.S. Departments. Examples are social programs through HEW and DOL, housing assistance through HUD, sewer, water and drainage through EPA.

The scope of this project did not permit an investigation of all of the various state and federal discretionary programs available for each of the types of community services described in the report. However, further investigation could be made by contacting State Planning offices or through research of a "Catalog of Federal Domestic Assistance" available through the Office of Management and Budget, Washington, D.C.

Because of the nature of non-permanent community facilities, many of the governmental financing tools described in Table VI-4, such as revenue bonds or other long-term financing would not be practical financing methods. In the case of state and federal programs, most of these are annual programs and are funded at the discretion of the President or Governor with approval from federal and state legislators, thus causing uncertainty as to the availability of future funds. In addition, the application and approval process for various funds is time consuming and in many cases may require considerable local capability.

GOVERNMENT FUNDS

Because of these constraints, we have attempted to define further only those governmental funding alternatives which may best lend themselves to mobile type communities.

- Leasing/Installment Purchase

  As the "Tax Lead Time Study" indicates, "it is often possible for counties, home-rule cities, statutory cities and towns, and districts to acquire equipment or provide facilities through leasing. This financing approach gives local governments an alternative for the acquisition of equipment or construction of public facilities, temporary or permanent, without direct borrowing."[9]

  A variety of leasing arrangements have been tried by various governments with the lessor being a private leasing corporation or a public nonprofit corporation. Leasing companies will lease most types of equipment and facilities to both public and private organizations. There are also specialized leasing firms who lease strictly to public organizations. These firms are generally familiar with legislation defining a public body's right to lease and can better structure their leases to deal with the public sector's special circumstances. Several non-profit corporations have been specifically created to acquire equipment and/or facilities to be leased to local governments. These corporations are discussed later under Non-Profit Corporation Financing.

  A major variable in local government leasing arrangements is the structure of the lease itself. There are wide variations in the term of the lease, options to renew, and disposition of undepreciated capital in non full-payout leases. These differences generally respond to the special needs and constraints of local governments and can be combined in a variety of ways to suit the particular problem at hand. The lease structure for a given project must be carefully considered. Input from a party independent of the lessor, such as an investment banker, can be very valuable in achieving the optimum structure of the lease.

  There are advantages to leasing such as being able to structure lease rates and terms that meet current fiscal needs. Funds can be provided in a short-term frame without an election and the lessee may acquire title and ownership of the property at the end of the lease period. Also, there may be no penalty for prepayment and if structured right, the local government debt capacity is not used.

There are a number of problems and disadvantages to leasing, not the least of which is the added cost of the money (about double what municipal bond money would cost). There may be a danger in that no clear legal definition exists for the difference between year-to-year renewable leases and local government indebtedness incurred by installment purchase contracts. "Leasing from non-profit corporations is a new concept which involves a number of technical complexities. Professional familiarity with the technique is essential if crucial problems are to be avoided."[10]

- Non-Profit Authority Financing
  A popular method to provide financing for community facilities in impacted areas has been to establish state sponsored non-profit authorities. This method has made it possible for public bodies, who have found it undesirable, impractical or impossible, to issue their own bonds to obtain financing. Financing normally takes the form of tax-exempt bonds issued by the authority to provide funds to assist communities in establishing public facilities.

  A recent example of such a non-profit agency within the Old West Region is the establishment of the Wyoming Community Development Authority in 1975. This authority was specifically created to assist impacted areas and was formulated to serve a more diversified scope than most financing authorities. An exerpt taken from the Act creating the authority follows: "It is hereby declared that there exists in this state by reason of the location and expansion of mineral extractive industries and other industrial developments, an acute shortage of adequate municipal, educational, recreational, cultural and other community facilities, and public services and municipally owned utilities, which conditions threaten and adversely affect the health, safety, morals and welfare of the people of this state. It is further declared that a critical shortage of adequate housing exists in the state because of the location and expansion of industries and industrial developments and the lack of funds of private mortgage lending institutions of the state which are available to finance new housing at reasonable rates. It is further declared that the rapidly expanding or expected population of the state cannot be provided with such needed facilities and services by conventional planning and financing sources. It is further declared that the provisions of this act constitute a valid public purpose, of primary benefit to all citizens of the state of Wyoming."[11]

Discussion with the existing director of the authority and the authorities' attorney revealed that mobile facilities such as those described in the report may qualify for assistance from this act.

Because of the broad scope and nature of the act and its relative newness, the exact methodology of how the authority might assist in the developing of mobile community facilities is unknown. However, there may be a number of possibilities such as:

- Direct short-term loans to municipalities from an
- authority revolving fund
- Third-party leasing agreements
- Purchase and lease of facilities by the authority to the local community
- Purchase of a local government bonds or notes

There are several advantages to non-profit corporations or financing authorities. It should open the door for cost savings on certain projects by financing with tax-exempt bonds rather than taxable borrowing. These cost savings could make needed projects economically feasible, that otherwise would not be undertaken. Cost savings also may arise because the non-profit corporation's bonds could be more marketable. Use of non-profit corporation financing may also preserve debt capacity and the expense and nuisance of public referenda. When the local government is the lessee of a facility purchased or constructed by a non-profit corporation, its lease payments will always be less than in the case of a comparable lease with a private leasing firm because of tax-exempt financing and very low administrative costs. The ability of the local government to exercise control over the non-profit corporation is substantially greater than it would be with a private corporation.

One disadvantage is the question of the immediate availability of an authority such as the one described for Wyoming. At the time of this writing the legality of the authority is being tested in Wyoming, therefore, it is not known how or when this body could be used for financial support. An added problem is that the entity is an additional public agency with which local government would have to cope.

It has been shown that finance agencies or non-profit corporations have a good record of performance in responding to a variety of difficult financing needs and seems logical that they could play an effective role in the Old West region's response to the impact. For further information, reference should be made to the "Tax Lead Time Study" and the Wyoming Community Development Authority Act.

- State Taxes for Impact Assistance
  Another reasonable method of providing front-end funds to impact areas is the collection and disbursement of severance taxes on mineral production to impacted localities. An example of such a tool is the authority created by "Coal Tax for Impact Assistance Act" recently passed in Wyoming. In addition to other taxes provided by law, the tax will be imposed for the privilege of extracting or producing coal. Monies will be administered by the Wyoming Farm Loan Board and will be disbursed by the Board for use in areas which are directly or indirectly impacted by the production of coal. The financing of public water, sewer, highway, road or street projects will result. According to the

law, the Farm Loan Board may pledge or otherwise contract with any county, city, town, sewer district, water district or other political subdivisions of the state.

These funds may also be pledged on behalf of the local entity to the Wyoming Community Development Authority in support of tax-exempt bonds issued by the Authority.

We have not completely investigated each states' situation as to impact taxes or their use for mobile facilities. For further information, one should contact appropriate state officials or investigate state legislation related to the collection and use of mineral extraction taxes.

The obvious advantage of using this kind of tax is the distribution of funds (obtained from those industries causing and profiting from impact) to areas of greatest impact.

However, as one company explains "it is important for each state to be reasonable as it imposes taxes, to be competitive with other states and to consider that taxes can be levied on industry which yield the highest benefit to the state for the least cost to industry."[12]

o Joint Powers Agreement

Another tool for financing assistance has been the "Joint Powers" acts established by several states. This legislation permits two or more governmental agencies such as a county, town, school districts, etc., to jointly plan, create, expand, finance and operate facilities related to water, sewerage or solid wastes, recreation, police protection, fire protection, transportation, public facilities, medical care, courthouse, jail and administration.

With this mechanism, a financially strong county may assist a small town or district within that town or even another nearby county to finance needed facilities by helping to secure debt, providing needed assistance, or by engaging in activities otherwise not possible for that county.

CONCLUSION

The financing of mobile facilities in many ways is similar to financing permanent facilities. There are many variables which change with each specific situation and effect financing alternatives. In addition, there are a number of problems and constraints relative to front-end financing of facilities in impact areas which are compounded if those facilities happen to be short-term or non-permanent structures. In spite of the problems, there are a variety of options available to finance community facilities such as those described in this report although some options appear much more reasonable and realistic. In the final analysis, one must analyze the specific set of circumstances and requirements related to a particular community service program and impact area. Based on the many options or combination of options defined in this report, the planners must choose the one which is available and best meets their specific needs.

FOOTNOTES

1 R. L. Lindauer, Jr., Manager, Public Affairs, Rocky Mountains Exxon Company, USA, Denver, Colorado, Solutions to the Economic Impacts of Large Mineral Developments on Local Governments. Paper; Published by Federation of Rocky Mountain States, Inc., in Energy Development in the Rocky Mountain Region: Goals & Concerns, July, 1975.

2 Colorado Regional Development and Land Use Planning Subcommittee, Tax Lead Time Study, Colorado Geological Survey, Department of Natural Resources, State of Colorado, Denver, Colorado, 1974.

3 Ibid

4 Ibid

5 Ibid

6 R. L. Lindauer, Jr., Manager, Public Affairs, Rocky Mountains Exxon Company, USA, Denver, Colorado, Solutions to the Economic Impacts of Large Mineral Developments on Local Governments. Paper; Published by Federation of Rocky Mountain States, Inc., in Energy Development in the Rocky Mountain Region: Goals & Concerns, July, 1975.

7 Colorado Regional Development and Land Use Planning Subcommittee, Tax Lead Time Study, Colorado Geological Survey, Department of Natural Resources, State of Colorado, Denver, Colorado, 1974.

8 R. L. Lindauer, Jr., Manager, Public Affairs, Rocky Mountains Exxon Company, USA, Denver, Colorado, Solutions to the Economic Impacts of Large Mineral Developments on Local Governments. Paper; Published by Federation of Rocky Mountain States, Inc., in Energy Development in the Rocky Mountain Region: Goals & Concerns, July, 1975.

9 Colorado Regional Development and Land Use Planning Subcommittee, Tax Lead Time Study, Colorado Geological Survey, Department of Natural Resources, State of Colorado, Denver, Colorado, 1974.

10 Ibid

11 43rd Legislature of the State of Wyoming, Wyoming Community Development Authority Act, Session Laws of Wyoming, 1975.

12 R. L. Lindauer, Jr., Manager, Public Affairs, Rocky Mountains Exxon Company, USA, Denver, Colorado, Solutions to the Economic Impacts of Large Mineral Developments on Local Governments. Paper; Published by Federation of Rocky Mountain States, Inc., in Energy Development in the Rocky Mountain Region: Goals & Concerns, July, 1975.

RECOMMENDATIONS

"...WE MUST SEARCH FOR OUR OBJECTIVES AND METHODS IN THE FUTURE, RATHER THAN IN THE PAST."

ALVIN TOFFLER
FUTURE SHOCK

The following recommendations are the results of our Temporary/Mobile Facilities for Impacted Communities" study.

1. Conduct a demonstration project utilizing a broad range of temporary/ mobile facilities applied to an impact growth situation.

   A demonstration project in one or more of the four areas of significant impact growth (Lake Sakakawea, Green River Basin, Powder River Basin, and Big Horn/Tongue River Basin) would be both timely and of considerable value in assessing the degree of feasibility of using temporary/mobile facilities. In this regard communities in the four significant impact areas consistently ranked the following issues very high: lack of adequate housing, lack of adequate school facilities, limited capacity of existing infrastructure.

2. Investigate the use of contemporary communication medias to expand community services.

   Adult education and cultural programs could be implemented via television or expanded by traveling exhibits and other mobile cultural operations. E.F.T.S. (Electronic Fund Transfer System) could be installed to provide basic banking services.

3. Investigate methods to reduce infrastructure installation and reclamation costs.

   The costs involved in installing and reclaiming components of the infrastructure (utility distribution and collection system) are expensive, because they are generally designed as permanent installations. There are basically two approaches to this problem. Utilize a temporary/portable system or eliminate the distribution/ collection network. Further investigation into the previously discussed portable piping system should prove worthwhile. With elimination in mind, power could be supplied to dwellings from solar collectors and/or wind generators. The abundant amount of sunlight and wind generally in the Old West Region enhance the potential of this concept.

4. Investigate site reclamation alternatives.

After a community has "pulled up stakes" what happens to the land? Much of the infrastructure may have been left behind along with roadways, walks, and floor slabs. Further research may lead to portable floor decking, less earth moving, or even land reclamation utilizing treated community wastes.

5. Initiate Federal Legislation to nationally standardize highway regulations regarding mobile home transport.

Consistant interstate transport regulations would reduce shipping time and lower its cost.

6. Investigate additional methods of procuring financial assistance to help plan and develop community facilities in impacted communities.

Numerous studies have resulted in the past five years that address the problem of financing facilities for new or existing communities. The criteria of the Wyoming Community Development Authority and Coal Tax for Impact Assistance Act (Wyoming Legislature) has provided some answers to this question. However, additional investigation is necessary in this area. The costs of planning for impending growth and development (pre-planning and engineering related costs) have been discussed by economists, planners, elected officials, etc., but the problem has yet to be resolved.

In order for a project (regardless of its nature) to take place financing of the project is fundamental. The general tendency is to ask for financing from the federal government or float a bond issue at the local level. Traditional methods of financing community facilities, especially temporary/mobile facilities have severe limitations. Alternative financial techniques must be developed in order to pay for the service demands associated with rapid industrial growth.

The national education of the populace and public servants, regarding impact problems is critical if major developments are to occur. Public interest will stimulate new ideas and initiate programs to resolve today's problems. Broadscope awareness and resultant planning is essential in our "global village". Provincialism is of the past.

An idea or concept is truly successful when all the elements and their relationships work harmoniously to develop the whole concept. An overall plan or view, sympathetic with each element and corresponding relationships has to be established before the components are dealt with individually. Such as, an artist who must conceive a complete thought or total image before physical representation commences. Only then can textures, shapes, colors, lines, etc., be brought harmoniously together under the common framework of one idea. Once synthesis is complete the work can then be viewed as a whole. As in abstract design, physical design is developed conceptually but experience and practical value are achieved only through physical implementation.

APPENDIXES

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CLIMATE

The Old West Region is situated in an area marked by a continental climate. This climatic type is influenced largely by the interactions of three large air masses which have their origins over the polar regions, northern Pacific Ocean and the Gulf of Mexico. Warm, moist, gulf air tends to dominate weather in summer and cold, polar air masses affect the Old West Rigion in winter. The seasonal dominance of these air masses and associated frontal activity creates the general weather regimens in the Old West Region.

The highest mean annual precipitation within the Old West Region occurs in the mountainous areas, ranging from 30 to over 40 inches in portions of the Northern Rockies. The Great Plains average about 12 to 20 inches annually and the Central Lowlands average about 24 inches. The Basin/Range Province has the lowest annual average at about 8 inches. Geographic diversity in the mean annual precipitation pattern over the Old West Region is shown in the adjacent exhibit.

Much of the area's annual precipitation varies seasonally and occurs as rain during the frost free period, with a maximum coming in late spring and early summer. Summer precipitation is marked by localized thundershowers of high intensity. This activity is capable of producing damaging floods and severe hail. Annual variations in rainfall are also a characteristic feature of the area, especially in the Great Plains. The plains are known for their severe droughts that can last from a single summer to several years in duration.

Snow accounts for much of the annual precipitation that falls in the mountainous and Black Hills areas of the OWR. Here an annual average snowfall of 100 inches or more is common. Snowfall in the Great Plains is relatively light in comparison to the mountainous area of the OWR. Average annual snowfall for the plains is about 40 to 50 inches.

All areas in the Old West Region experience a wide range of temperature variation between winter and summer. Temperatures higher than 100^{o} F.

in the summer and appreciably lower than 0^{0} F. in the winter have been recorded in the region. Extremes range from a summer high of 121^{0} F. in Steele, North Dakota to a low of -70^{0} F. at Rogers Pass, Montana.

Temperatures in the region also show a definite latitudinal difference. This variation in temperature is illustrated in Figures A-3&4. This shows the distribution of mean daily maximums and minimums throughout the Old West Region for January and July. The winter isotherms indicate the general moderation of cold polar outbreaks as they move from the northwest to southeast. Penetration of a particular air mass type in the summer over the region is not as pronounced in that the mean

HEATING DEGREE DAYS

SOURCE: Climatic Atlas, p. 33

TABLE A-1

	STATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	ANNUAL
MONTANA	Billings	6	15	186	487	897	1135	1296	1100	970	570	285	102	7049
	Glasgow	31	47	270	608	1104	1466	1711	1439	1187	648	335	150	8996
	Great Falls	28	53	258	543	921	1169	1349	1154	1063	642	384	186	7750
	Havre	28	53	306	595	1065	1367	1584	1364	1181	657	338	162	8700
	Helena	31	59	294	601	1002	1265	1438	1170	1042	651	381	195	8129
	Kalispell	50	99	321	654	1020	1240	1401	1134	1029	639	397	207	8191
	Miles City	6	6	174	502	972	1296	1504	1252	1057	579	276	99	7723
	Missoula	34	74	303	651	1035	1287	1420	1120	970	621	391	219	8125
NEBRASKA	Grand Island	0	6	108	381	834	1172	1314	1089	908	462	211	45	6530
	Lincoln	0	6	75	301	726	1066	1237	1016	834	402	171	30	5864
	Norfolk	9	0	111	397	873	1234	1414	1179	983	498	233	48	6979
	North Platte	0	6	123	440	885	1166	1271	1039	930	519	248	57	6684
	Omaha	0	12	105	357	828	1175	1355	1126	939	465	208	42	6612
	Scottsbluff	0	0	138	459	876	1128	1231	1008	921	552	285	75	6673
	Valentine	9	12	165	493	942	1237	1395	1176	1045	579	288	84	7425
SOUTH DAKOTA	Huron	9	12	165	508	1014	1432	1628	1355	1125	600	288	87	8223
	Rapid City	22	12	165	481	897	1172	1333	1145	1051	615	326	126	7345
	Sioux Falls	19	25	168	462	972	1361	1544	1285	1082	573	270	78	7839
NORTH DAKOTA	Bismark	34	28	222	577	1083	1463	1708	1442	1203	645	329	117	8851
	Devils Lake	40	53	273	642	1191	1634	1872	1579	1345	753	381	138	9901
	Fargo	28	37	219	574	1107	1569	1789	1520	1262	690	332	99	9226
	Williston	31	43	261	601	1122	1513	1758	1473	1262	681	357	141	9243
WYOMING	Casper	6	16	192	524	942	1169	1290	1084	1020	657	381	129	7410
	Cheyenne	19	31	210	543	924	1101	1228	1056	1011	672	381	102	7278
	Lander	6	19	204	555	1020	1299	1417	1145	1017	654	381	153	7870
	Sheridan	25	31	219	539	948	1200	1355	1154	1054	642	366	150	7683

temperatures do not differ greatly from south to north. The summer range between average daily maximums and minimums is greater than in the winter months.

Annual heating degree days (HDD) are the number of days that the daily average temperature falls below 65° F., or when heating is not normally required in a building. HDD in the Old West Region as shown in Figure E-6 vary with latitude and elevation. The higher latitudes and elevations present a larger annual total number of HDD than do the lower latitudes and elevations, and therefore require a greater heating load.

As illustrated in Figure E-7, the mean annual amount of sunshine in the Old West Region varies from 2400 to 3100 hours. The monthly distribution of sunshine for selected stations is displayed in Table A-2

In the summertime sunshine is greatest in total hours of occurrence. Intensity is also greatest at this time, especially at higher altitudes where the atmosphere is lighter and there is a relative absence of fog,

SUNSHINE: MEAN HOURS

SOURCE: Climatic Atlas, p. 67

TABLE A-2

	STATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
MONTANA	Billings	140	154	208	236	283	301	372	332	258	213	136	129	2762
	Great Falls	154	176	245	261	299	299	381	342	256	206	132	133	2884
	Havre	136	174	234	268	311	312	384	339	260	202	132	122	2874
	Helena	138	168	215	241	292	292	342	336	258	202	137	121	2742
	Missoula	85	109	167	209	261	260	378	328	246	178	90	66	2377
NEBRASKA	Lincoln	173	172	213	244	287	316	356	309	266	237	174	160	2907
	North Platte	181	179	221	246	282	310	343	304	264	242	184	169	2925
	Omaha	172	188	222	259	305	332	379	311	270	248	166	145	2997
	Valentine	185	194	229	252	296	323	369	236	275	242	174	172	3037
NORTH DAKOTA	Bismark	141	170	205	236	279	294	358	307	243	198	130	125	2686
	Devils Lake	150	177	220	250	291	297	352	302	230	198	123	124	2714
	Fargo	132	170	210	232	283	288	343	293	222	187	112	114	2586
	Williston	141	168	215	260	305	312	377	328	247	206	131	129	2819
SOUTH DAKOTA	Huron	153	177	213	250	295	321	367	320	260	212	142	134	2844
	Rapid City	164	182	222	245	278	300	348	317	266	228	164	144	2858
WYOMING	Cheyenne	191	197	243	237	259	304	318	286	265	242	188	170	2900
	Lander	200	208	260	264	301	340	361	326	280	233	186	185	3144
	Sheridan	160	179	226	245	286	303	367	333	266	221	153	145	2884

CLIMATE: AVERAGE ANNUAL PRECIPITATION

SOURCE: CLIMATIC ATLAS

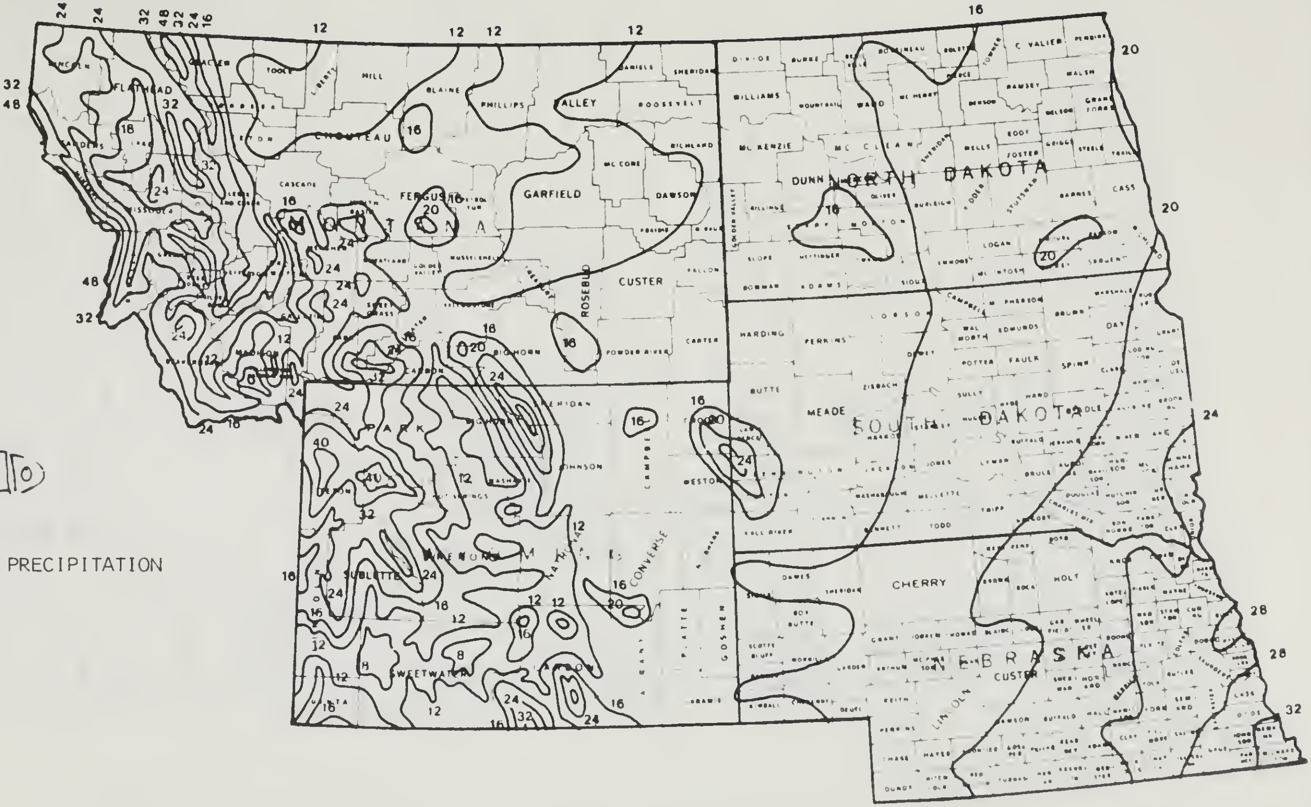

FIGURE A-1

LEGEND

INCHES OF PRECIPITATION

haze and smoke.

An important environmental consequence from the low annual mean temperatures experienced in the Old West Region is the extensive frost penetration throughout the region. Average annual frost penetration ranges from over 60 inches in extreme northeastern North Dakota to 20 inches in the valleys of the Northern Rockies. Extreme frost penetration of 100 inches has occurred in the Red River Valley of North Dakota, which is among the highest depths reported in the coterminous United States. The presence of soil frost is especially significant in terms of applying the temporary facility concept to the placement of sewer and water lines.

Average annual wind speeds over the Old West Region range from approximately 6 to 14 miles per hour. Wind flow patterns and speeds vary according to local topographic situations and seasonal weather phenomena.

In the Northern Rockies & Wyoming Basin/Range provinces wind speeds are generally greater. Winds tend to be gusty in the rugged terrain. Locally these winds may be funnelled through canyons and valleys, forced over ridges, or routed around mountains. Under fair weather conditions, mountain and valley breezes are generated by relief. In the mountainous areas, wind directions are usually southwesterly to northwesterly throughout the year and rarely exceed 30 miles per hour for periods longer than an hour.

Areas of more uniform topography such as the Great Plains experience large variations in wind velocity and direction. Surface wind speeds are generally high. The great velocities in this area occur in the winter and spring. However, the highest intensity winds happen during the summer months in association with thunderstorms as well as cyclonic and tornadic activity. Wind directions are from south and southeast in summer and north and northwest in winter. Two characteristic weather phenomenon in the plains area during the winter and early spring are blizzards and chinooks. Blizzards are strong winds accompanied by snow and chinooks are relatively warm, dry, downslope winds occurring principally at the mountain/plains interface.

CLIMATE:
AVERAGE ANNUAL SNOWFALL

SOURCE: CLIMATIC ATLAS

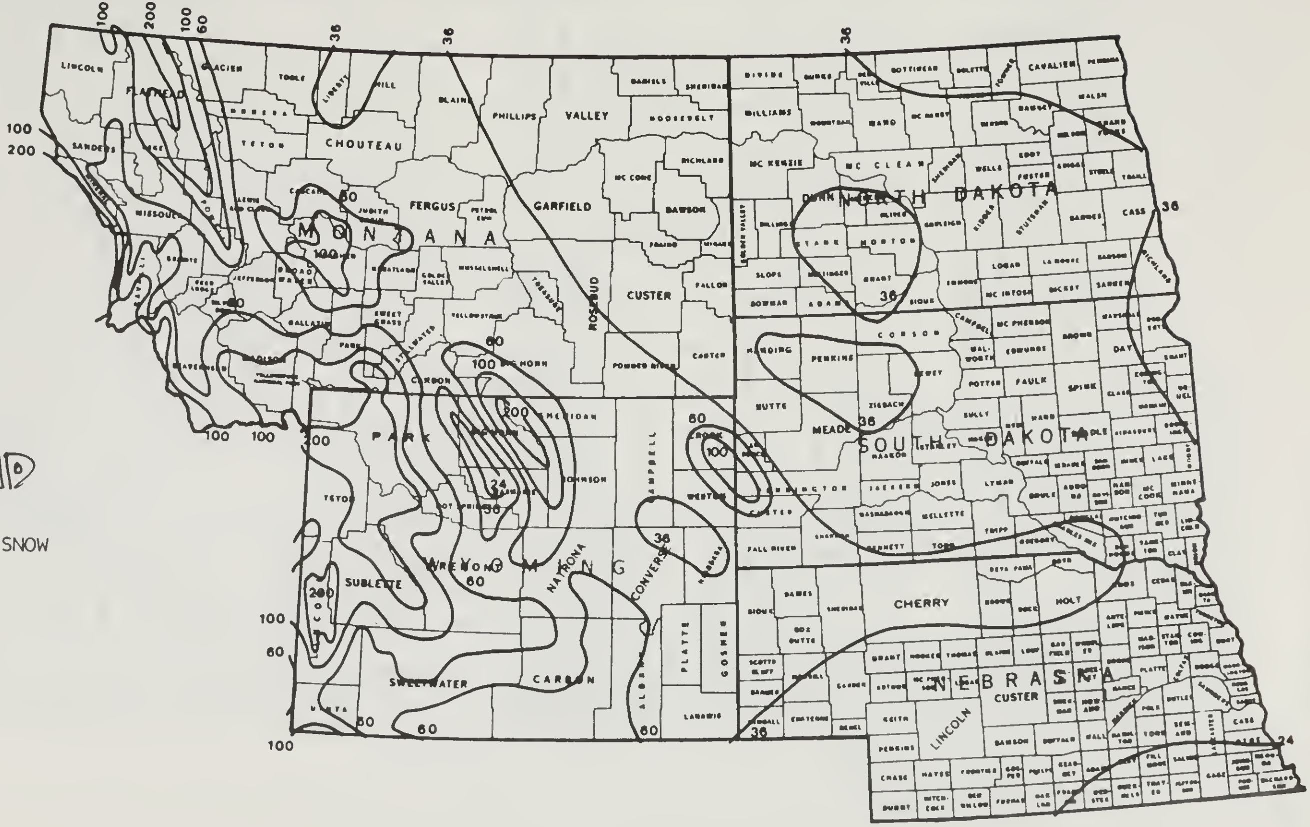

FIGURE A-2

LEGEND

INCHES OF SNOW

GEOLOGY

Geology of the Old West Region is complex and diverse. The general distribution of rock formations throughout the Old West Region is shown in Figure A-8. The mountainous regions are generally composed of hard crystalline and sedimentary rocks, whereas the plains area is underlain primarily by a sequence of sedimentary rocks.[2]

Rocks of pre-paleozoic age underlie the entire region. Common rock types are granite, gneiss schist and quartzite. Outcrops of these rocks occur principally in the mountainous areas of the region and in extreme southeastern South Dakota. Associated with these outcrops on the flanks of many uplifted areas are Paleozoic rocks composed of dolomite, shale, sandstone and limestone.

Mesozoic rocks also appear in the Old West Region, but not in association with pre-Paleozoic rocks This rock formation consists of shale and sandstone in the lower part of the sequence with limestone and chalk occurring in the upper parts, especially in the eastern and southern sections of the region.

A sedimentary sequence of Tertiary rocks mainly composed of shales, sandstones, clays, silts and sands form an extensive sheet throughout the Great Plains. They also form a major part of the rocks occupying the basin areas within the mountainous provinces.

The youngest rocks in the Old West Region, sometimes referred to as mantle rock, are of the Quaternary period. They are comprised of unconsolidated glacial, fluvial and eolian deposits. Glacial till is found primarily in the northern and eastern segments of the Old West Region. Fluvial material (water deposited) has accumulated in large deposits in south-central Nebraska and underlies less extensively the flood plain and adjacent terraces along many of the region's major drainageways. Eolian deposits, such as dune sand and loess, form a mantle over the older rocks in the southeastern portion of the Old West Region.

CLIMATE: MEAN MONTHLY TEMPERATURE / MAX. JULY

SOURCE: CLIMATIC ATLAS & DECENNIAL CENSUS OF U.S. CLIMATE, 1951-1960

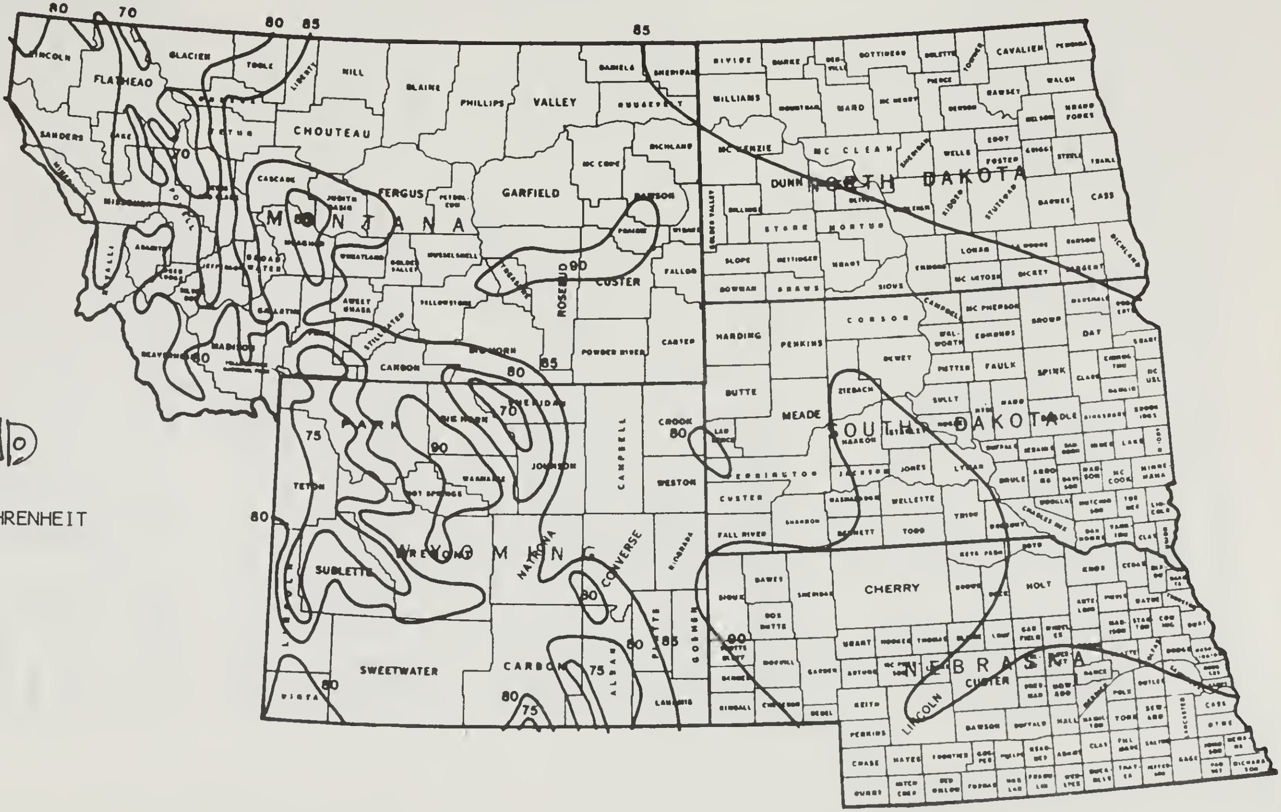

FIGURE A-3

LEGEND

DEGREES FAHRENHEIT

Detailed information about soil characteristics in terms of permeability rates, depths to bedrock and stability is important in the siting and design of temporary/mobile facilities. Residual and transported soils occupying various parts of the Old West Region include: Alluvial soils, Brunizems or prairie soils, Chernozems, Chestnut soils, Brown soils, Podzols, Sierozems and Lithosols. Soil and subsurface limitations are significant to the application of temporary facilities in the Old West Region as they can pose development problems in the way of costly utility, street and foundation construction.

HYDROLOGY

Principal drainage basins in the Old West Region are depicted in Figure A-9. Four great river systems are evident: (1) the Missouri, (2) the Columbia, (3) the Colorado, and (4) the Souris-Red. Many major sub-basins and minor basins occur within the four river systems. Other surface water features include numerous small ponds and lakes, many intermittent streams and several large, man-made reservoirs.

The North American Continental Divide meanders diagonally in a north to south direction across Montana and Wyoming. In the southern part of Wyoming the divide intersects a large area of intermittent streams and interior drainage. Hydrographically termed the Great Divide Basin, this area of internal drainage covers about 5,000 square miles. Two other areas of interior drainage occur in central North Dakota.

The mountain ranges in the Northern Rockies and Wyoming Basin/Range province are the source of many of the Old West Region's principal rivers. Wide variations in seasonal flow characterize these rivers.[4] The winter is usually a time of low flow, whereas the late spring/early summer season is a period of maximum streamflow. This period of maximum streamflow is caused by the combination of snowmelt in the mountains and plateaus mixing with run-off from spring rainfall in the lower elevations. Low streamflow usually prevails during the late summer and early fall.

CLIMATE: MEAN MONTHLY TEMPERATURES / MIN. JANUARY

SOURCE: CLIMATIC ATLAS & DECENNIAL CENSUS OF U.S. CLIMATE, 1951-1960

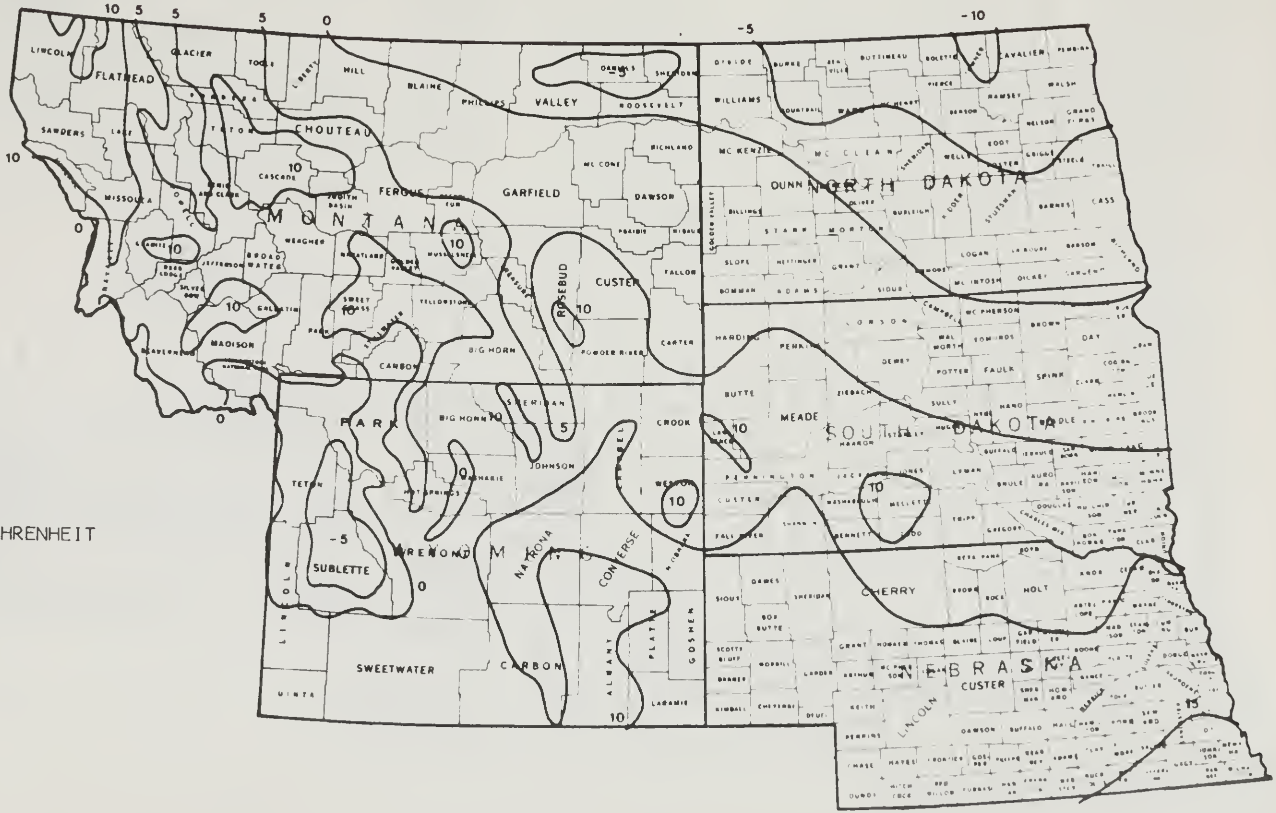

FIGURE A-4

LEGEND

DEGREES FAHRENHEIT

However, the most variable streams in the region are those that originate in northeastern South Dakota and southeastern North Dakota. Streams draining the Sand Hills of Nebraska are quite stable throughout the year.

Surface water supplies in the western segment of the Old West Region vary by province.[5] Low rainfall coupled with small and intermittent streamflow in the Basin/Range province provides a relatively small supply of water. Major suppliers of surface water are the larger streams (Green, Platte, Bighorn and Wind Rivers) that have their headwaters in the bordering mountains. In contrast, the Northern Rocky Mountain province draws an adequate amount of surface water from its large number of perennial streams. The headwaters of the Missouri River have their origin in this province.

Principal sources of surface water for the remainder of the region as shown in the adjacent exhibit are the larger perennial streams and their tributaries. Because of the low to moderate and erratic rainfall, especially in the Great Plains area, many of these streams have wide seasonal fluctuations in flow.

DRAINAGE BASINS

TABLE A-3

1. Green River
2. Bear River
3. Snake River
4. Big Horn River
5. Platte River
6. Republican River
7. Niobrara River
8. White River
9. Cheyenne River
10. Belle Fouche River
11. Powder River
12. Tongue River
13. Little Missouri River
14. Bad River
15. Missouri Mainstem
16. James River
17. Vermillion River
18. Big Sioux River
19. Wild Rice River
20. Cheyenne River
21. Red River Tributaries
22. Souris River
23. Moreau River
24. Grand River
25. Missouri Coteau
26. Cannonball River
27. Green River
28. Knife River
29. Yellowstone River
30. Poplar River
31. Milk River
32. Musselshell River
33. Judith River
34. Sun-Marias River
35. Blackfoot River
36. Red Rock - Madison River
37. Clark Fork
38. Flathead River
39. Kootenai River
40. Saskatchewan River

Source: Various Agencies/Departments from OWR States

CLIMATE: ANNUAL HEATING DEGREE DAYS

SOURCE: CLIMATIC ATLAS

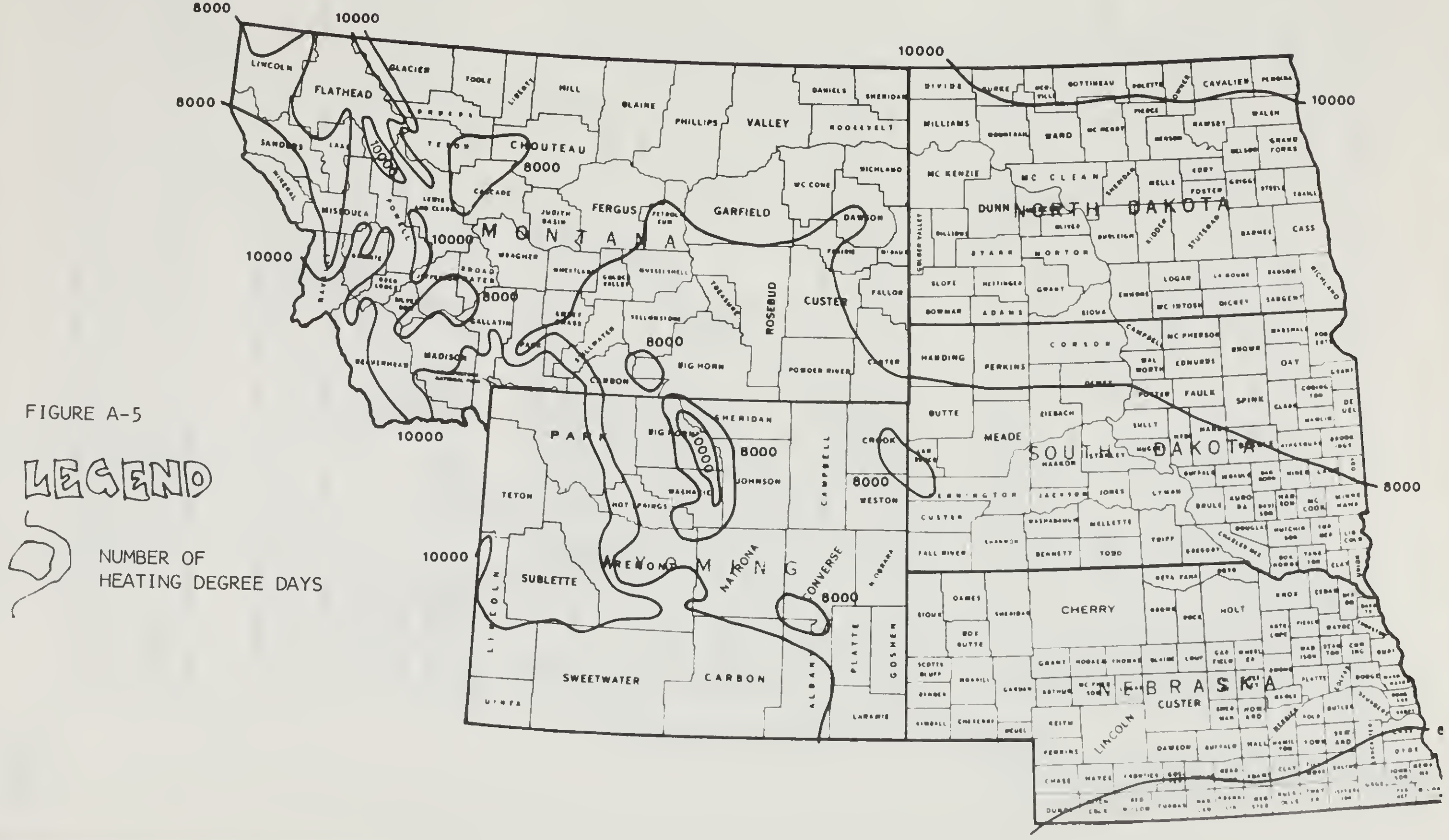

FIGURE A-5

LEGEND

NUMBER OF HEATING DEGREE DAYS

Groundwater is an important source of water supply in many areas of the Old West Region.[6] It occurs in sufficient quantities to meet most water needs, especially in many areas remote from perennial streams. Its abundance also has permitted development where surface water supplies are inadequate. Groundwater producing areas in the Old West Region are illustrated in Figure A-10. These areas are comprised of both unconsolidated and bedrock aquifers with water tables located at variable depths. The water table generally conforms to topographic areas, and may be within a few feet of the surface in stream valleys or as deep as several hundred feet in bedrock formations. In some areas of the region, increasing withdrawals of groundwater are causing a decline in the water table.

The unconsolidated aquifers are a major source of groundwater available to wells in the Old West Region. The water-bearing stratum includes alluvium in stream valleys, wind-deposited silt and sand, and a variety of glacial material and sediments. Yields are generally adequate but vary widely throughout the region. It appears that the more productive aquifers occur in the eolian deposits of Nebraska where the estimated yield per well exceeds 500 gallons per minute (gpm). Other areas of substantial water-bearing deposits are the intermountain basins of Montana and Wyoming, and areas with thick, extensive beds of stratified till material. These deposits are capable of producing from 300 to 1,000 gpm, and in some places only 50 gpm are available.

Among the various-aged bedrock formations, aquifers in the sediments of the Ogallala-Arikeree sequence (Tertiary age) are the second most important sources of groundwater in the region. This sequence, comprised mostly of compacted sand and gravel sediments, is distributed throughout Nebraska, Wyoming, South Dakota and Montana. Wells in this formation generally have yields from 300 to 1,000 gpm; more favorably situated wells can yield as much as 2,000 gpm.

Other bedrock formations of different geologic periods also serve as reliable sources of water supply in several areas of the Old West Region. These sources occur in places where the rocks are exposed or where they are buried beneath several hundred feet of younger formations.

CLIMATE: INSOLATION

SOURCE: CLIMATIC ATLAS

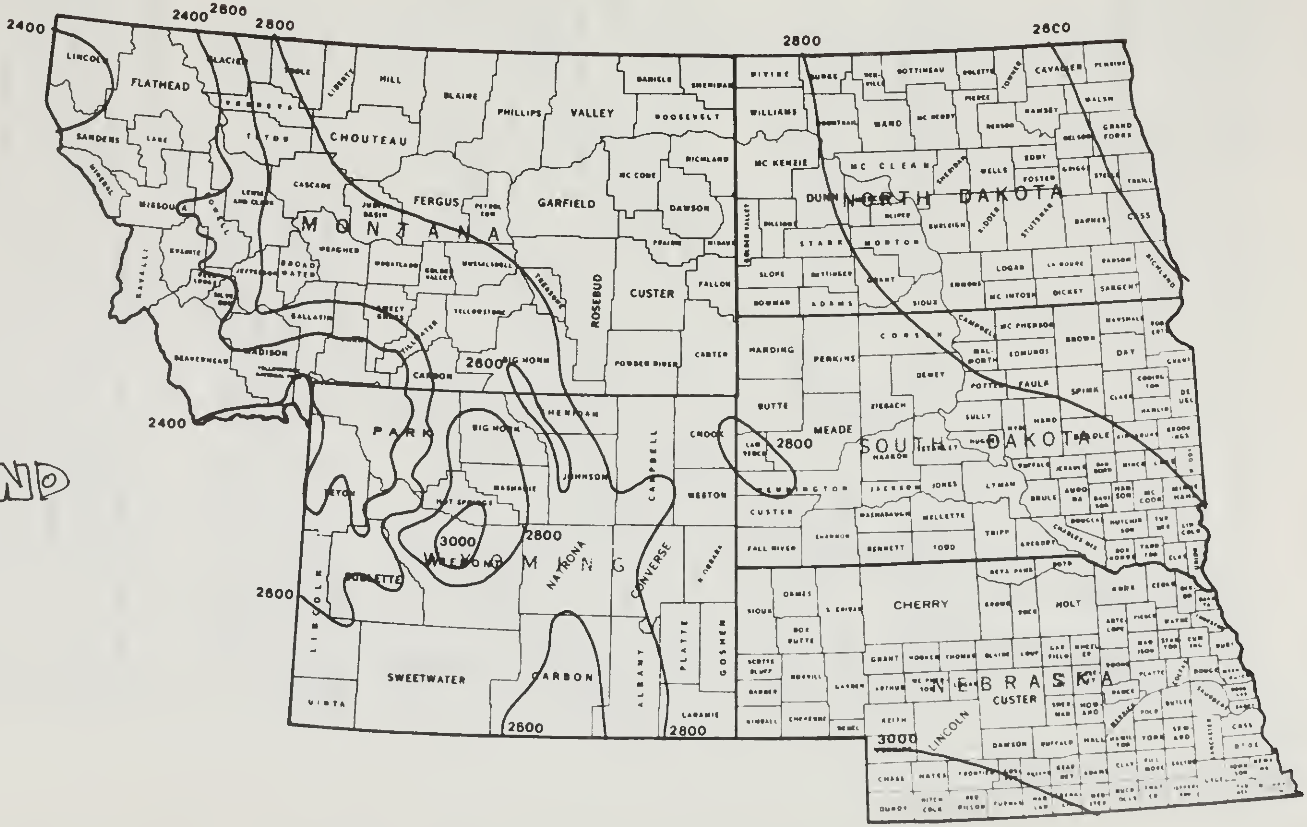

FIGURE A-6

LEGEND

HOURS OF SUNSHINE

Especially significant are the sandstone and shale aquifers of Mesozoic age (15 to 150 gpm yields) and the Paleozoic limestone and sandstone formations. The metamorphic and igneous rocks of pre-Paleozoic age serve as a water supply in areas where younger rocks have been removed by erosion.

NATURAL VEGETATION

Natural vegetation in the Old West Region is divided into three categories: (1) grasslands, (2) desert shrub and grasses, and (3) forest and woodlands.[7]

The grasslands and desert shrub and grassland combination occupy a majority of the region. They are found primarily in the Central Lowlands, Great Plains and Wyoming Basin/Range provinces. Major vegetative formations are the prairie and steppe/shrubland. The prairie is comprised of medium to tall grasses and is primarily found in association with the Central Lowlands and extreme eastern Great Plains. Broadleaf forest cover is present in some of the perennial stream floodplains and intermittent streams throughout the prairie as well as in scattered hardwood groves.

The steppe/shrublands are distributed over the remainder of the Great Plains and much of the Basin/Range province. They consist of an extensive cover of mixed short grasses and shrubs. In many areas shrubs such as sagebrush sometimes dominate this vegetative formation.

The Northern Rockies, Black Hills and areas of higher elevation in the Wyoming Basin/Range province include an extensive cover of coniferous forests and intermingled mountain parks supporting mixed grasses and shrubs. The common species in the mountain forest are the Englemann spruce, Douglas fir and lodgepole pine, with the western yellow (ponderosa) pine covering the lower slopes. Spruce and ponderosa pine are the principal species in the Black Hills.

CLIMATE: FROST PENETRATION

SOURCE: U.S. DEPT. OF COMMERCE/ WEATHER BUREAU

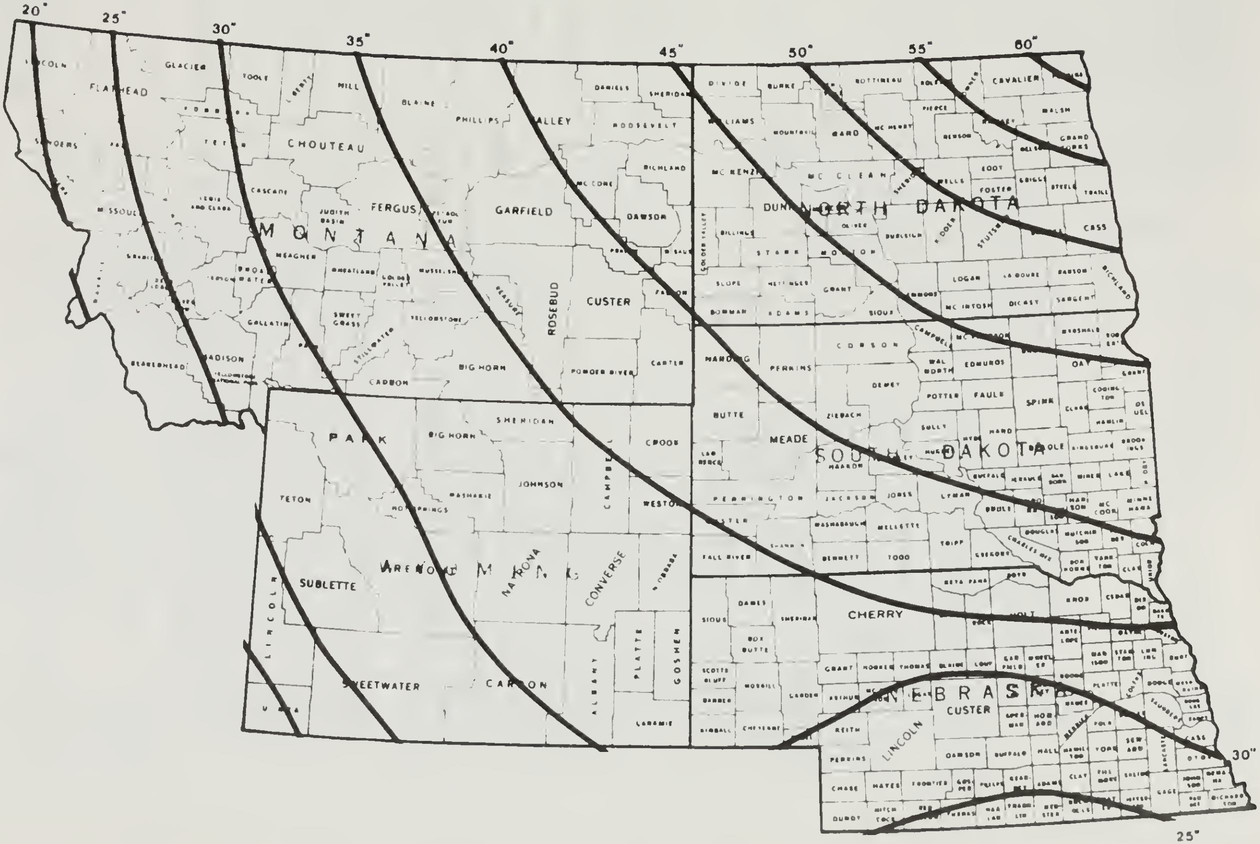

FIGURE A-7

LEGEND

DEPTH OF FROST
IN INCHES

Crops, pasture and urban uses have replaced much of the original vegetation in the Great Plains.

EARTH STABILITY

Information about the physical properties and engineering characteristics of bedrock units and unstable surface deposits in the Old West Region is necessary to identify and evaluate conditions considered favorable for installation and operation of mobile/temporary facilities. There are places in the region where geologic conditions impose constraints to the location of various temporary/mobile structures and utilities. A discussion of these constraints follows.

As shown in Figure A-12, seismic or earthquake activity has occurred throughout the Old West Region. The area of highest seismicity is located in the Northern Rocky Mountain province. Earthquakes recorded in the Northern Rockies have the highest frequency of occurrence and have been according to the Modified Mercalli Scale of slight to moderate intensity. The remainder of the Old West Region may be considered relatively inactive with regard to earthquakes with high damage potential.

Other potential hazards associated with the Old West Region are landslides and subsidence. Areas where relatively steep slopes and weak ground soils exist are potentially unstable. These areas are highly susceptible to landsliding and occur throughout the region. In areas of karst topography and places where extensive underground mines occur the potential for ground subsidence exists.

TABLE A-4

MAXIMUM WIND VELOCITIES

AND CORRESPONDING DIRECTIONS

LOCATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
MONTANA												
BILLINGS	66	68	61	72	68	65	73	66	61	68	63	73
	W	NW	NW	NW	–	SE	N	N	NW	NW	NW	NW
GREAT FALLS	65	72	73	70	65	70	73	71	73	73	73	82
	SW	W	W	W	SW	W	W	SW	NW	W	SW	SW
HELENA	73	73	61	52	62	59	60	65	54	62	59	59
	SW	W	SW	W	S	SW	SW	S	NW	W	SW	NW
MISSOULA	52	53	53	51	57	51	72	58	41	51	42	56
	S	E	NE	NW	SW	S	SE	SW	W	SW	NW	W
NEBRASKA												
LINCOLN U	49	56	63	56	60	66	65	62	50	44	52	54
	NW	NW	NW	NW	W	NW	NW	NW	N	S	NW	NW
NORTH PLATTE	57	68	72	63	70	72	60	56	53	72	64	59
	N	N	N	NW	S	N	NW	SW	N	SW	NW	NW
OMAHA	60	59	73	65	73	72	109	66	51	59	58	52
	NW	N	NW	NW	NW	N	N	N	N	SW	NW	NW
SCOTTSBLUFF	40	60	48	46	80	80	52	41	46	44	52	47
	NW	WNW	W	NW	NW	WNW	WSW	NNW	NW	WNW	NW	NW
NORTH DAKOTA												
BISMARCK	70	54	65	63	66	66	72	72	66	61	67	61
	NW	NW	NW	W	NW	NW	W	S	NW	W	NW	NW
DEVILS LAKE	41	54	54	47	52	50	56	47	46	47	57	42
	NW	N	N	N	NW	W	NW	NW	NW	N	N	NW
FARGO	57	56	56	65	72	115	60	71	88	57	66	58
	W	W	N	N	NW	NW	SE	NW	N	NW	N	N
SOUTH DAKOTA												
HURON	57	56	68	73	70	65	77	70	64	72	73	56
	NW	NW	NW	SE	NW	SE	NW	S	NW	W	NW	NW
RAPID CITY	73	75	72	72	67	72	70	72	73	72	59	65
	NW	NW	NW	NW	NW	SW	SW	SW	NW	NW	NW	NW
WYOMING												
CHEYENNE	75	69	73	67	69	63	57	46	54	61	66	71
	NW	NW	W	NW	NW	NW	W	NW	W	W	W	W
LANDER	65	77	62	72	56	61	57	56	70	70	75	72
	SW	SW	SW	SW	SW	SW	W	SW	W	SW	N	SW
SHERIDAN	73	70	65	66	71	66	73	72	66	66	84	63
	NW	W	SW	NW	NW	SW	W	NW	NW	NW	SW	NW

GEOLOGY

SOURCES: NATIONAL ATLAS & TERRAIN ANALYSIS & HNTB (MAJOR GEOLOGIC AREAS OF DEMARCATION)

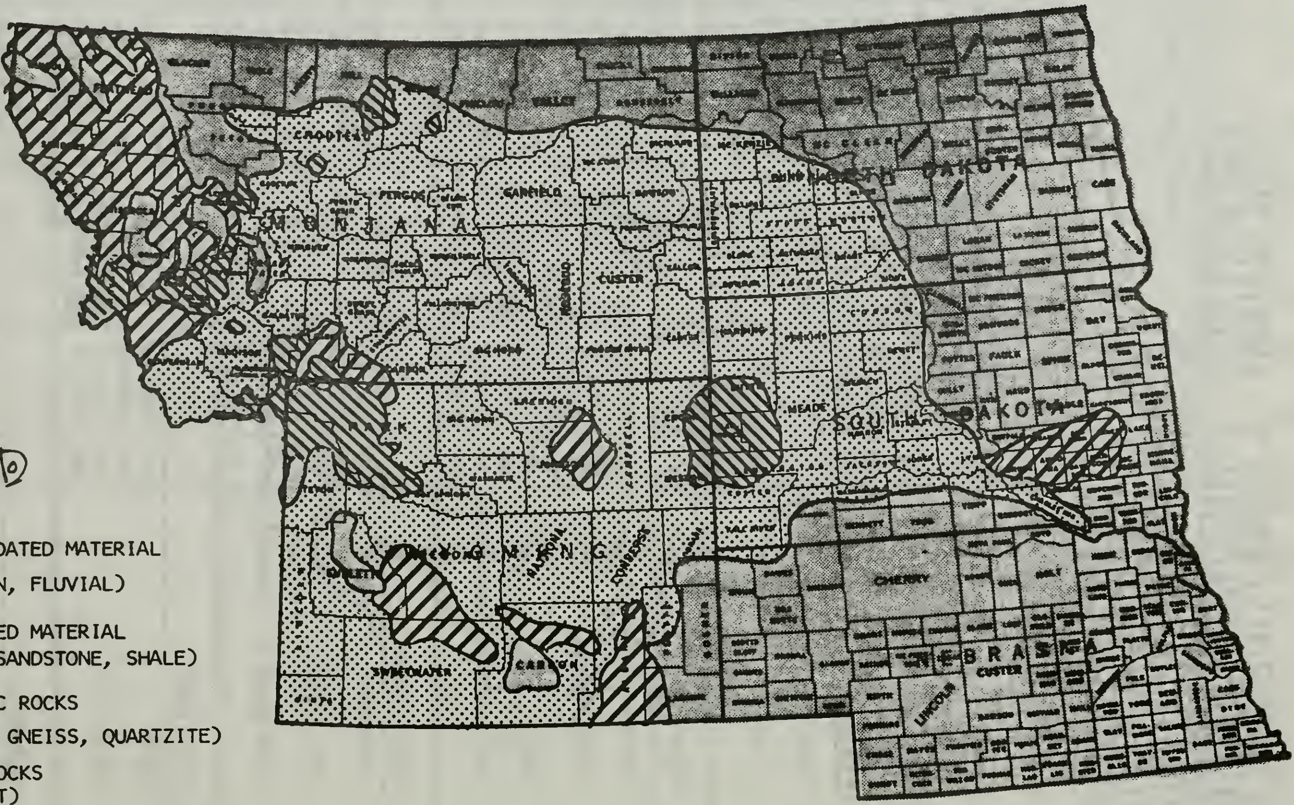

FIGURE A-8

LEGEND

☐ UNCONSOLIDATED MATERIAL (GLACIAL, EOLIAN, FLUVIAL)

▒ CONSOLIDATED MATERIAL (CONGLOMERATE, SANDSTONE, SHALE)

▨ METAMORPHIC ROCKS (SLATE, SCHIST, GNEISS, QUARTZITE)

▧ IGNEOUS ROCKS (GRANITE, BASALT)

HYDROLOGY: DRAINAGE BASINS

SOURCES: NATIONAL ATLAS & WATER RESOURCES DEPARTMENTS OF VARIOUS STATES

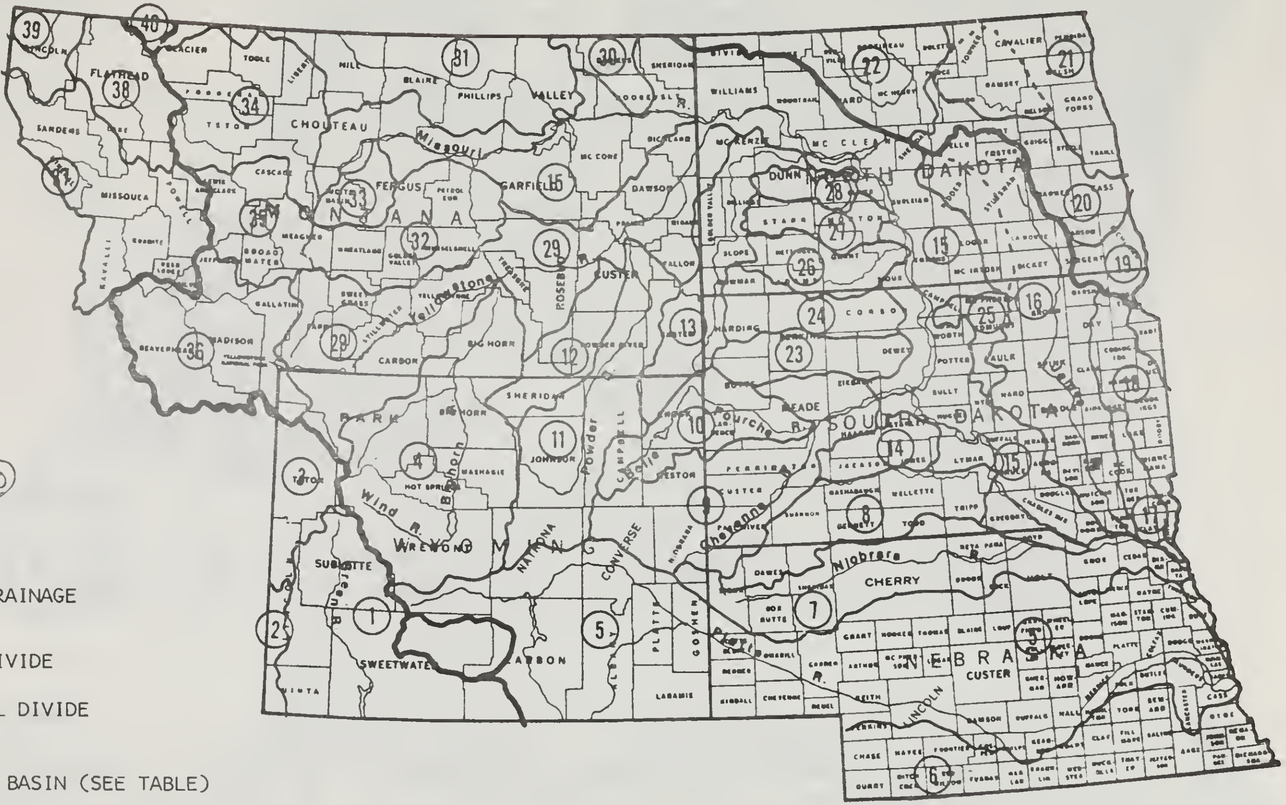

FIGURE A-9

LEGEND

( ) INTERNAL DRAINAGE

∽ DRAINAGE DIVIDE

∽ CONTINENTAL DIVIDE

① IDENTIFIES BASIN (SEE TABLE)

HYDROLOGY: GROUNDWATER

SOURCE; NATIONAL ATLAS

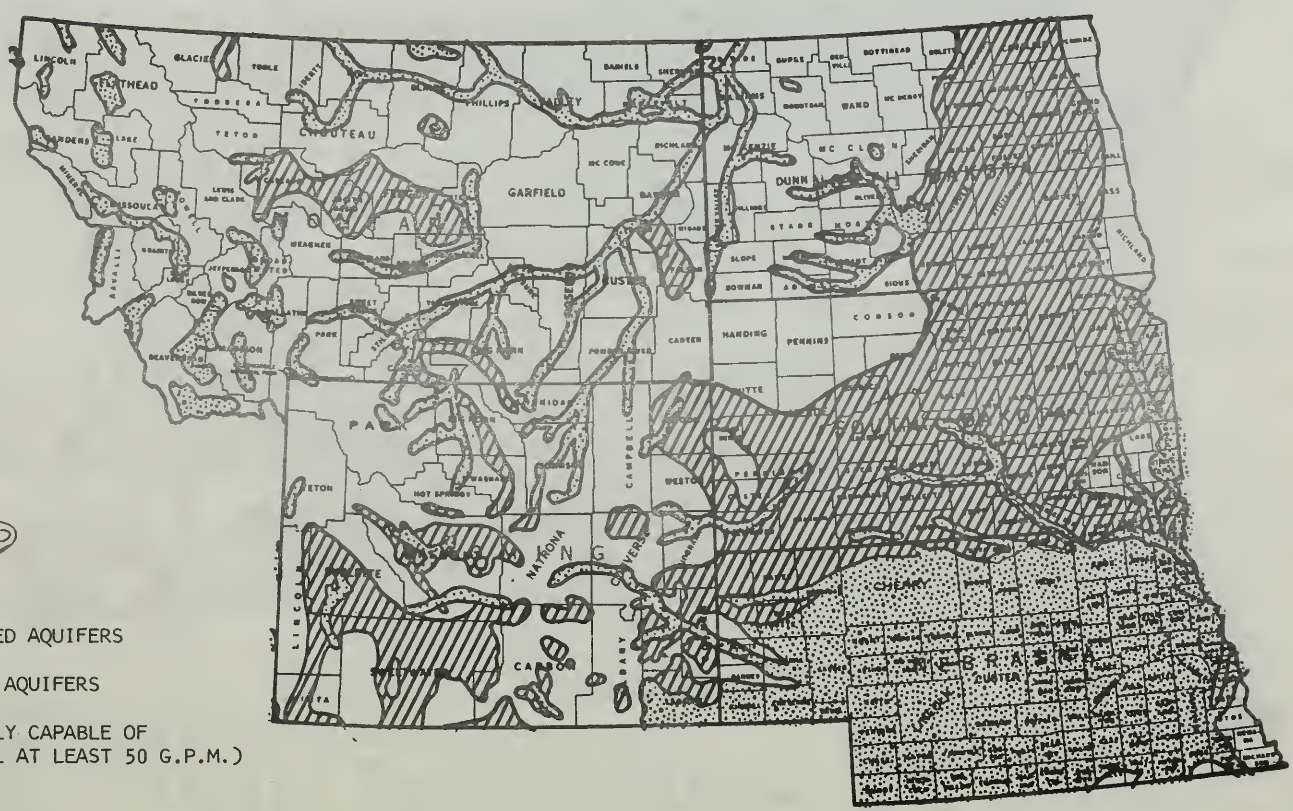

FIGURE A-10

LEGEND

░ UNCONSOLIDATED AQUIFERS

▨ CONSOLIDATED AQUIFERS

(AQUIFERS GENERALLY CAPABLE OF
YIELDING TO A WELL AT LEAST 50 G.P.M.)

NATURAL VEGETATION

SOURCE: NATIONAL ATLAS

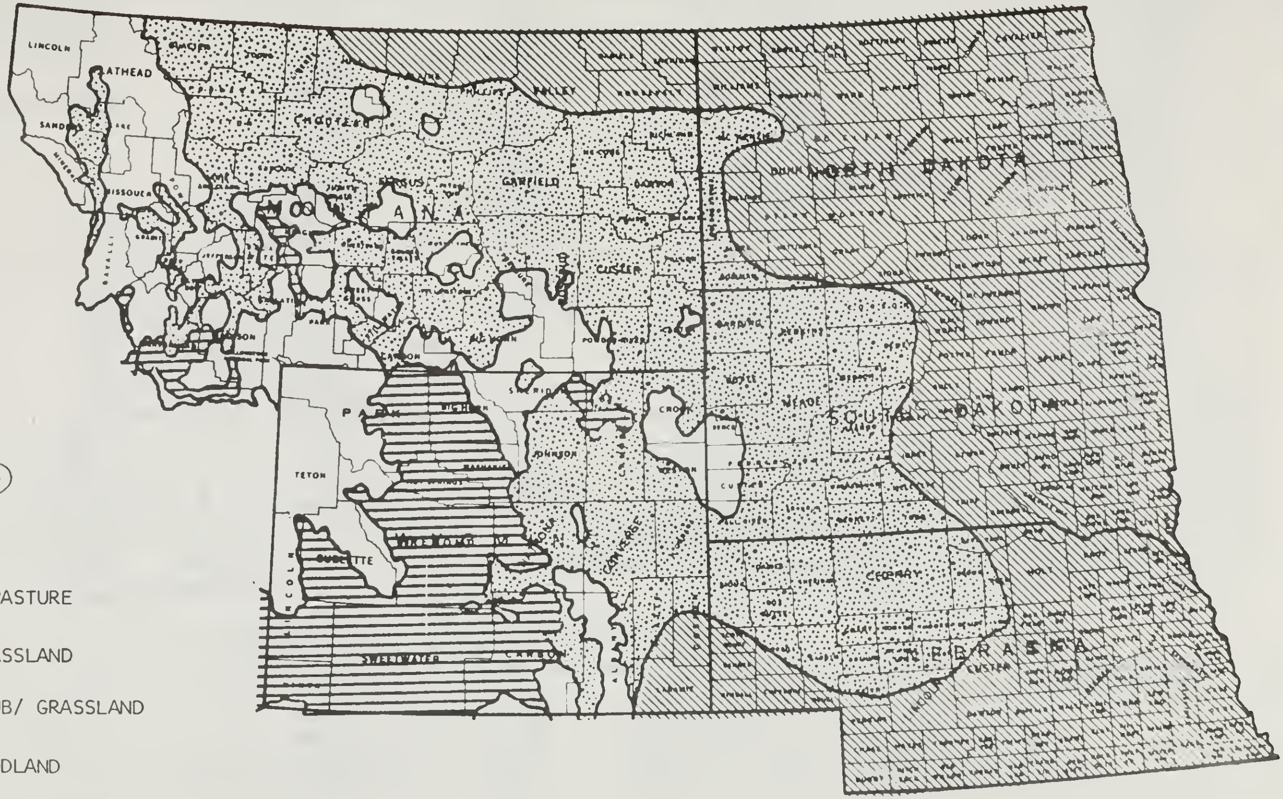

FIGURE A-11

LEGEND

▨ CROPLAND/ PASTURE

░ CENTRAL GRASSLAND

☰ DESERT SHRUB/ GRASSLAND

☐ FOREST/ WOODLAND

EARTH SURFACE STABILITY

SOURCE: NATIONAL ATLAS

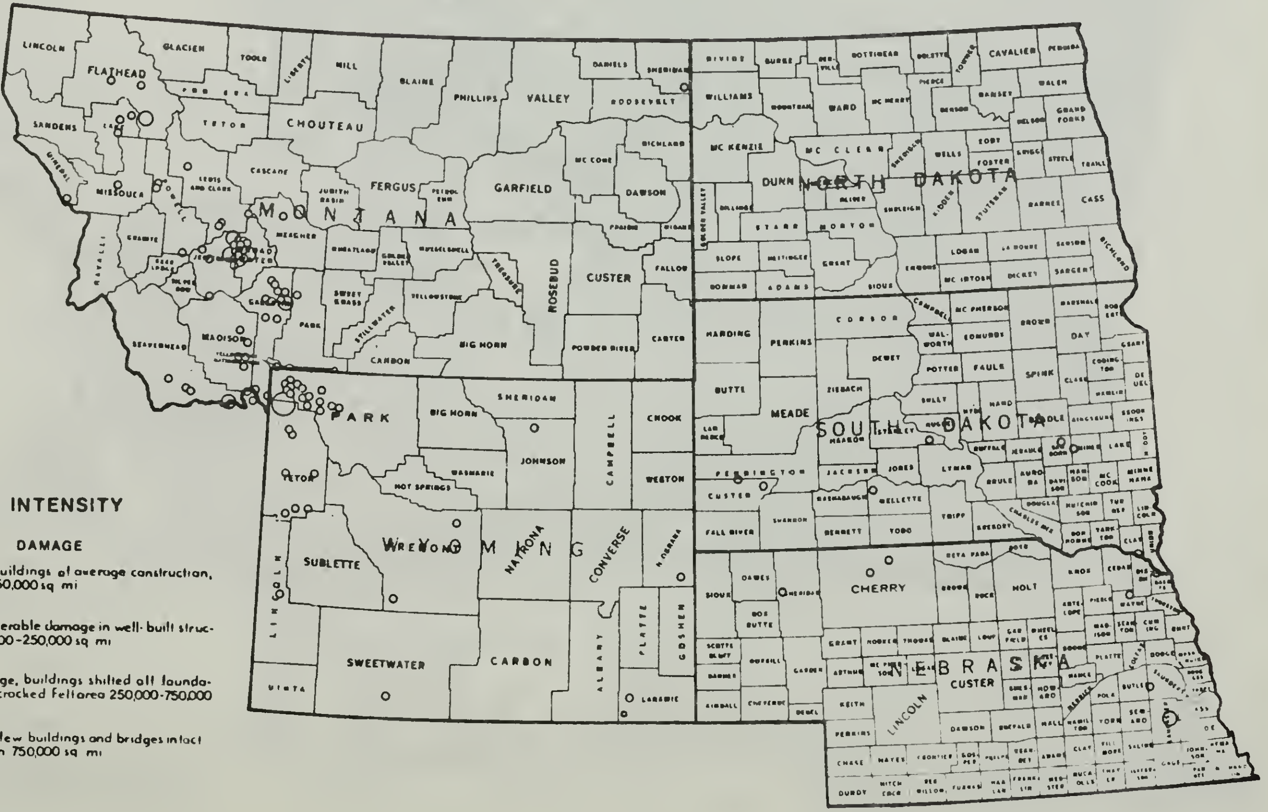

FIGURE A-12

EARTHQUAKE INTENSITY

INTENSITY		DAMAGE
V VI	∘	Slight damage in buildings of average construction, Felt area less than 50,000 sq mi
VII-VIII	○	Moderate to considerable damage in well-built structures Felt area 50,000-250,000 sq mi
IX-X	○	Considerable damage, buildings shifted off foundations, ground badly cracked Felt area 250,000-750,000 sq mi
XI XII	◯	Near total damage, few buildings and bridges intact Felt area more than 750,000 sq mi

TABLE A-5

COAL DEPOSITS AND MINES

(1) Lignite and Brown Coal (2) Medium and High Volatile Bituminous Coal (3) Subituminous Coal

COUNTY	COVERAGE	TYPE
MONTANA		
Prairie	100%	1
Richland	100%	1
Sheridan	100%	1
Dawson	90%	1
Custer	80%	1
McCone	80%	1
Wibaux	80%	1
Fallon	55%	1
Daniels	50%	1
Roosevelt	50%	1
Carter	20%	1
Powder River	15%	1
Garfield	10%	1
Powell	10%	1
Beaverhead	5%	1
Rosebud	5%	1
Valley	5%	1
Fergus	10%	2
Cascade	5%	2
Judith Basin	5%	2
Musselshell	50%	3
Powder River	50%	3
Rosebud	40%	3
Big Horn	30%	3
Yellowstone	10%	3
Treasure	5%	3
SOUTH DAKOTA		
Harding	30%	1
Perkins	30%	1

COUNTY	COVERAGE	TYPE
NORTH DAKOTA		
Prairie	100%	1
Burke	100%	1
Divine	100%	1
Dunn	100%	1
Golden Valley	100%	1
Hettinger	100%	1
McKenzie	100%	1
Mercer	100%	1
Mountrail	100%	1
Stark	100%	1
Williams	100%	1
McClean	98%	1
Oliver	95%	1
Ward	90%	1
Slope	85%	1
Adams	70%	1
Bowman	70%	1
Renville	65%	1
Morton	55%	1
Grant	50%	1
Sheridan	15%	1
Burleigh	10%	1
WYOMING		
Lincoln	10%	2
Crook	5%	2
Sweetwater	5%	2
Teton	5%	2
Uinta	5%	2
Weston	5%	2

COUNTY	COVERAGE	TYPE
WYOMING		
Campbell	70%	3
Sheridan	50%	3
Johnson	30%	3
Converse	15%	3
Carbon	5%	3
Lincoln	5%	3
Preston	5%	3
Sublette	5%	3
Sweetwater	5%	3
Teton	5%	3
Uinta	5%	3

THE NINE LARGEST STRIP BITUMINOUS COAL MINES IN THE OLD WEST REGION - 1974

COMPANY	(Tons) PRODUCTION	STATE
Decker Coal Co.	6,786,000	Montana
Amax Coal Co.	3,312,858	Wyoming
Arch Minerals Corp.	3,142,400	Wyoming
Pacific Power & Light Co.	2,687,045	Wyoming
Arch Minerals Corp.	2,589,752	Wyoming
Kemmerer Coal Co.	2,436,835	Wyoming
Peabody Coal Co.	2,228,524	Montana
Rosebud Coal Sales Co.	1,963,316	Wyoming
Knife River Coal Mining Co.	1,722,079	N.D.
TOTAL PRODUCTION	26,868,809 TONS	

State and Federal standards regarding mobile homes and community development is the emphasis of this section. Generally key areas of the most stringent codes in the Old West Region will be outlined. A commentary of the standard will follow. The federal register on mobile home construction, state standards for transportation, water, solid waste, sewage, and air quality will be discussed respectively.

CONSTRUCTION CODES

"In August, 1974, Congress passed the National Mobile Home Construction and Safety Standards Act of 1974. This act calls for the establishment of pre-emptive Federal Construction and Safety Standards for mobile homes and also directs the Secretary to conduct mobile home safety research and development."[59] These federal standards have been established and will become effective on June 15, 1976.

PLANNING CONSIDERATIONS

Scope

- The intent of this subpart is to assure the adequacy of architectural planning considerations which assist in determining a safe and healthful environment.

Light and Ventilation

- Each habitable room shall be provided with exterior windows and/or doors having a total glazed area of not less than 8% of the gross floor area.

Ceiling Heights

- Every habitable room and bathroom shall have a minimum ceiling height of not less than 7 ft., 0 in. for a minimum of 50% of the room's floor area. The remaining area may have a ceiling with a minimum height of 5 ft., 0 in.

Exit Facilities

- Mobile homes shall have a minimum of two exterior doors located remote from each other.
- Every sleeping room, unless it has an exit door, shall have at least one outside window which meets the requirements of 280.404.

Room Requirements

- Every mobile home shall have at least one living area with not less than 150 sq. ft. of gross floor area.
- All bedrooms shall have at least 50 sq. ft. of floor area.

Hallways

- Hallways shall have a minimum horizontal dimension of 28 in.

FIRE SAFETY

Scope

- The purpose of this subpart is to specify measures which will provide a reasonable degree of safety from fire for the occupants. It is the intent of this part that mobile homes shall be constructed so as to reduce fire hazards and provide detection of a fire for safe egress.

Flame Spread

- The interior finish of all walls and partitions shall not have a flame spread rating exceeding 200.
- All ceiling interior finish shall not have a flame spread rating exceeding 200.
- Furnace and water heater space shall be enclosed by surfaces not exceeding 25.
- Exposed interior finishes adjacent to the cooking range shall not exceed 50.

Firestopping

- Firestopping shall be provided to cut off all concealed draft opening in all stud walls and partitions.

Fire Detection

- At least one smoke detector shall be installed in each mobile home to protect each separate bedroom area.

Materials

- See chart. pt 40272

BODY AND FRAME CONSTRUCTION

Scope

- This subpart covers the minimum requirements for materials, products, equipment and workmanship needed to assure that the mobile home will provide:

FIRE SAFETY

TABLE A-6

Aluminum: Aluminum Construction Manual, specifications for aluminum structures.	AA-1971
Steel:	
Specification for the design, fabrication, and erection of structural steel for building with supplements 1,2, and 3 (junior beams meeting ASTM A36 are acceptable if designed to meet the loading and performance requirements of this standard.	AISC-1969
Specification for the design of cold-formed steel structural members with supplement 1.	AISI-1968
Specification for the design of light-gage cold-formed stainless steel structural members.	AISI-1972
Standard specifications for open web steel joints, J- and H-Series	AISC and SJI
Criteria for structural applications of steel cables for buildings	AISI-1973
Wood and wood products:	
Hardboard	PS 58,59, and 60-1973
Hardwood and decorative plywood	USDC PS51-71
Structural design guide for hardwood plywood	HPMA-SG-71
Timber, structural glued laminated--inspection	AITC-200-1973
Timber, structural glued laminated	USD PS56-73
Construction and industrial plywood	PS 1-74
Plywood residential construction guide	APA-1975
Design specifications for plywood--lumber components	APA-1974
Fabrication specifications of plywood--lumber components	APA-1975
Stress grade lumber and its fastenings--national design specifications for (and supplement)	(N) FPA-1973
Structural design data--wood	(N) FPA-1970
Span tables for joists and rafters (PS 20-70)	(N) FPA-1973
Working stresses for joists and rafters	(N) FPA-1974
Timber construction standards	AITC-100-1972
Design specifications for light metal plate connected wood trusses	TPI-74
Span tables for light metal plate connected wooden trusses	TPI-1972
Particleboard for mobile home decking	NPA 1-73
Mat-formed wood particleboard	CS 236-66
All plywood beams for mobile homes	APA 124-74
Wood flush doors (interior exterior)	NWMA I.S.1-74
Ponderosa pine panel doors	NWMAI.S.5-73
Wood window units	ANSI A200.1-74 (NWMA I.S.2-73)
Water repellent preservative treating for millwork	NWMAI.S.-4-70

1) Structural strength & rigidity.
2) Protection against corrosion, insects, decay, etc.
3) Wind protection.
4) Resistance to the elements
5) Durability & economy of maintenance

Structural Design Requirements

- All mobile homes in the Old West Region shall be designed for horizontal wind loads not less than 20 psf and a net uplift not less than 15 psf.
- All mobile homes in Old West Region shall be designed to resist a live load of 30 pst (roof load).
- The deflection for structural framing subjected to total design loads shall not exceed the following:
  - Floor ... L/240
  - Roof & Ceiling ... L/180
  - Headers, Beams, & Girders ... L/180
  - Walls & Partitions ... L/180
- Floors shall support a minimum uniform live load of 40 lb/ft^2

TESTING

Structural Load Tests

- Every structural assembly tested shall be capable of meeting the proof load test or the ultimate load test (280.401)

THERMAL PROTECTION

Scope

- This subpart sets forth the requirements for condensation control, air infiltration, thermal insulation and certification for heating and comfort cooling.

Condensation Control

- Ceilings shall have a vapor barrier having a permeance not greater than one perm (one grain of water/sq.ft./hr./inch of mercury pressure difference).
- Unventilated exterior walls shall have a vapor barrier having a permeance not greater than one perm installed on the living space side of the wall cavity.

Heat Loss

- The transmission heat loss of mobile homes in the Old West Region shall not exceed 11.3 BTU/sq. ft at - 20^{0} F. Mobile homes in this area shall be factory equipped with storm windows or insulating glass.
- Mobile home thermal insulation shall not be less than the following:
  Wall ... R-11
  Floor ... R-11
  Ceiling ... R-14

PLUMBING SYSTEM

Scope

- It is the intent of this subpart to assure water supply, drain, waste, and vent systems which permit satisfactory functioning and provide for health and safety under all conditions of normal use.

General Requirements

- The plumbing system shall be of durable material, free from defective workmanship, and so designed and constructed as to give satisfactory service for a reasonable life expectancy.

Materials

- Materials, fixtures, or devices used or entering into the construction of plumbing systems in any mobile home shall be free from defects and shall conform to approved standards or to applicable standards in the following table.

Joints and Connections

- Joints and connections shall be gastight and water tight for the pressures required under testing procedures.

Traps and cleanouts

- Each plumbing fixture except listed toilets shall be separately trapped by approved water seal "p" traps. All traps shall be effectively vented.

Plumbing Fixtures

- Plumbing fixtures shall have smooth impervious surfaces, be free from defects and concealed fouling surfaces, be capable of resisting road shock and vibration, and shall conform in quality and to listed standards.

PLUMBING MATERIALS

TABLE A-7A

MATERIALS	ANSI	ASTM	PS	OTHER STANDARDS
Ferrous pipe and fittings				
Cast iron screwed fittings	B16.4--1971			
Malleable iron screwed fittings	B16.3--1971			
Special cast iron fittings				IAPMO PS 5--1966
Welded wrought iron pipe	B36.2--1969	A72--168		
Wrought steel and wrought iron pipe	B36.10--1970			
Black and hot dipped zinz-coated (galvanized) seamless steel pipe.		A120--1972a		
Welded and seamless steel pipe	B125.1--1972	A53--1972a		
Pipe threads (except dry-seal)	B2.1--1968			
Cast iron soil piping and fittings	A112.4.1--1971	A74-1972	WW-P-4010 1969	
Nonferrous pipe and fittings				
Seamless copper, pipe, standard sizes	H26.1--1973	B42--1972		
Wrought seamless copper and copper alloy tube	H23.4--1973	B251--1971		
Seamless copper water tube	H23.1--1973	B88--1972		
Copper drainage tube (DWV)	H23.6--1973	B306--1973		
Wrought copper and bronzesolder-joint pressure fittings	B16.22--1973			
Wrought copper and wrought copper alloy solder joint drainage fittings	B16.29--1966			
Cast brass solder-joint pressure fittings	B16.18--1972			
Cast bronze solder-joint drainage fittings-DWV	B16.12--1969			
Cast bronze fittings for flared copper tubes	B16.26--1967			
Seamless red brass pipe standard sizes	H27.1--1973	B43--1972		
Cast bronze threaded fittings, 150 and 300 pound	B16.15--1971			
Plastic pipe and fittings, ABS plastic drain, waste, and vent pipe and fittings		D2661--1973	L-P 322B 1973	IAPMO PS 17-71 NSF
PVC plastic drain, waste, and vent pipe and and fittings		D2665-1973	L-P-320B 1973	IAPMO PS 27-69 NSF-14-1970
Chlorinated poly (vinly/chloride (CPVC) plastic hot water distribution systems		D2846-1973		NSF-14-1970
Polybutylene (PB) plastic pipe (SDR-PR)		D2772-1973		
Polybutylene (PB) plastic hot water distribution system		D3309-1974		
Mscellaneous pipe nipples, threaded			WW-N-351B(1) 1970	
Rubber gaskets for cast iron soil pipe fittings		C564-1970		
Backflow prevention devices	A112.14.1 1975			IAPMO PS 31-1971
Valve, bronze, gate 125-150 and 200 pound			WW-V 54D-1973	
Valve, cast iron gate, threaded and flanged			WW-V 58B-1971	

Hangers and Supports

- Piping in a plumbing system shall be installed without undue strains and stresses, and provision shall be made for expansion, contraction, and structural settlement.

Water Distribution System

- Water supply - piping systems shall be sized to provide an adequate quantity of water to each plumbing fixture at a flow rate sufficient to keep the fixture in a clean and sanitary condition without any danger of backflow or siphonage.
- Number of Fixtures / Tubing Diameter

Number of Fixtures	Tubing Diameter
1	1/4"
2	3/8"
3	1/2"
4	1/2"
5	3/4"

Drainage System

- The drainage system shall be designed to provide an adequate circulation of air in all piping with no danger of siphonage, aspiration, or forcing of trap seals under conditions of ordinary use.
- Drain pipe sizes shall be determined by the type of fixture and the total number connected to each drain.

Minimum Diameter	Fixtures
1 1/2"	1 to 3
2"	3 or more
3"	all toilets

Vents and Venting

- Each plumbing fixture trap shall be protected against siphonage and back pressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vents installed in accordance with the requirements of the uniform plumbing code or local authorities.
- The drain piping for each toilet shall be vented by a 1 1/2 in. minimum diameter vent connected to the main drain.
- An anti-siphon trap vent may be used as a secondary vent system for plumbing fixtures protected by traps not larger than 1 1/2 in.
- Each vent pipe shall extend not less than 2 in. above the roof.

TABLE A-7B

MATERIALS	ANSI	ASTM	PS	OTHER STANDARDS
Plumbing-fixture-setting compound			HH-C-536A-1954	
Cast brass and tubing P-traps				IAPMO PS 2-1966
Relief valves and automatic gas shutoff devices for hot water supply systems.	Z21.22-1971			
Solvent cement for ABS plastic pipe and fittings		D2235-1973		NSF-14-1970
Solvent cement for PVC plastic pipe and fittings		D2564-1973		NSF-14 1970
Anti-siphon trap vent device (reserved) diversion tees and twin waste elbow.				IAPMO PS 9-1966
Flexible copper water connectors				IAPMO PS 14-1971
Dishwater drain airgaps				IAPMO PS 23-1968
Coated feexible metal gas connectors for exterior use				IAPMO TSC 9 1972
Plumbing Fixtures				
Plumbing fixtures for land use			WW-P 541D-1971	
Vitreous china plumbing fixtures	A112.19.2 1973			NSF-24-
Enameled cast iron plumbing	A112.19.1 1973			
Porcelain enameled formed steel plumbing fixtures				IAPMO TSC 22 1972
Formed metal porcelain enameled sanitaryware				IAPMO PS 5-1967
Plastic bathtub units	Z124.1-1974			NSF-24-1972
Gel-coated glass-fiber reinforced polyester resin shower receptor and shower stall unit	Z124.2-1967			NSF-24-1972
Stainless steel plumbing fixtures-residential use				CS-243-1962 NSF-24 1972
Drains for prefabricated and precast showers				IAMPO PS 4-1966 NSF-24 1972
Cultured marble lavatory				IAMPO PS 18-1972
Prefabricated shower receptors, shower enclosures and non-metallic bathtubs				IAPMO PS 11-1972
Performance specifications and methods of test for safety glazing material used in buildings	97.1-1972			NSF-24-72

Test and Inspection

- All water piping in the water distribution system shall be subjected to a pressure test. The test shall be made by subjecting the system to water at 100 psi for 15 minutes without loss of pressure.

HEATING, COOLING, AND FUEL BURNING SYSTEMS

Scope

- This subpart covers the heating, cooling, and fuel burning equipment installed within, on, or external to a mobile home.

Minimum Standards

- Heating, cooling, and fuel burning appliances and systems in mobile homes shall be free of defects and shall conform to applicable standards in the following table unless otherwise specified in this standard. pg 40289

Heat Producing Appliances

- Heat producing appliances and vents, roof jacks and chimneys necessary for their installation in mobile homes shall be listed or certified by a nationally recognized testing agency for use in mobile homes.

Cooling Appliances

- Every air conditioning unit or a combination air conditioning and heating unit shall be listed or certified by a nationally recognized testing agency for the application for which the unit is intended and installed in accordance with terms of its listing.

Circulating Air System

- The minimum dimension of any branch duct shall be at least 1 1/2 in. and any main duct 2 1/2 in.

ELECTRICAL SYSTEMS

Scope

- This subpart and part A of article 550 of the National Electrical Code (NFPA No. 70-1975) cover the electrical conductors and equipment installed within or on mobile homes and the conductors that connect mobile homes to a supply of electricity.
- In addition to the requirements of this standard and article 550 of the National Electrical Code (NFPA No. 70-1975) the applicable portions of other articles of the National Electrical Code shall be followed covering electrical installations in mobile homes.

HEATING, COOLING & FUEL BURNING SYSTEMS

TABLE A-8

TYPE	ANSI	UL	OTHER STANDARDS
Appliances:			
Air conditioners, central cooling		465	
Liquid fuel-burning heating appliances for mobile homes and travel trailers	A147.1-1969	307(A)-1969	
Electric Air Heater	1025		
Electric Baseboard Heating Equipment	1042		
Electric Central Air-Heating Equipment	1096		
Gas-heating appliances for mobile homes & travel trailers		307(b)-1965	
Gas clothes dryers	Z21.5.1-1972		
	Z21.4.1a-1973		
	Z21.5.1b-1974		
Commercial gas-fired and electrically heated hot water generating equipment			NSF-5-1959
Gas-fired absorption summer air conditioning appliances	Z21.40.1-1973		
	Z21.401b-1974		
Gas fired gravity and forced air central furnaces	Z21.47-1973		
	Z21.47a-1974		
Gas-fired gravity and fan-type sealed combustion system wall furnaces	Z21.44-1973		
	Z21.44a-1974		
	Z21.44b-1975		
Commercial cooking and warming equipment		NSF-4-1967	
Household cooking gas appliances	Z21.1--1972		
	Z21.1a-1974		
Refrigerators using gas fuel	Z21.19-1974		
	Z21.19a-1972		
	Z21.19b-1973		
Automatic storage type water heaters with input less than 75,000 Btu/h.	Z21.10.1-1974		
	Z21.10.1a-1975		
Heating equipment, electric central air		1096	
Heat pumps		559	
Ferrous pipe and fittings:			
Black and hot dipped zinc-coated (galvanized)welded and seamless steel pipe for ordinary uses.			ASTM A120 1972a;WW-p 406D-1973
Electric resistance welded coiled steel tubing for gas and fuel oil lines			ASTM A539-1973
Pipe threads	B2.1-1968		
Wrought steel and wrought iron pipe	B36.10-1970		

- All electrical materials, devices, appliances, fittings, and other equipment shall be listed or labeled by a nationally recognized testing agency and shall be connected in an approved manner when in service.

Power Supply

- The power supply to the mobile home shall be a feeder assembly consisting of not more than one listed 50 ampere mobile home power-supply cords, or a permanently installed circuit.
- Where the calculated load exceeds 50 amps or where a permanent feeder is used the supply shall be by means of a mast weatherhead installation or an approved raceway.

Disconnecting means

- A single disconnecting means shall be provided in each mobile home consisting of a circuit breaker, or a switch and fuses and their accessories installed in a readily accessible location near the point of entrance of the supply cord or conductors into the mobile home.
- The distribution panelboard shall not be located in a bathroom, or in any other inaccessible location. A clear working space at least 30 inches wide and 30 inches in front of the distribution panelboard shall be provided.
- There shall be one or more circuits of adequate rating in accordance with the following:
    1) Amp rating of fixed appliances not over 50% of circuit rating if lighting outlets are on same circuit.
    2) For fixed appliances on a circuit without lighting outlets, the sum of rated amps shall not exceed the branch-circuit rating for other than motor loads or 80% of the branch-circuit rating for air conditioning or other motor loads.
    3) The rating of a single portable appliance on a circuit having no other outlets shall not exceed 80% of the circuit rating.
    4) Where laundry facilities are provided in a mobile home, a 20 amp branch circuit shall be provided within 6 ft of the intended location of the appliance.

Receptacle Outlets

- All receptacle outlets shall be:
  1) of grounding type
  2) installed according to section 210-7 of the National Electrical Code
  3) except when supplying specific appliances, be parallel-blade, 15-amp, 125-volt, either single or duplex.

Branch Circuits

- The number of branch circuits required shall be determined in accordance with the following:
  1) lighting area circuits determined by 3 watts/sq.ft.
  2) all 120 volt single phase B and 20 amp receptacle outlets installed outdoors and in bathrooms shall have ground-fault circuit protection for personnel.
  3) there shall be an individual outlet of the grounding type for each cord-connected fixed appliance installed.
  4) except in bath and hall areas, receptacle outlets shall be installed at wall spaces 2 ft. wide or more, so that no point along the floor line is more than 6 ft. measured horizontally, from an outlet in that space.

Fixtures and Appliances

- Electrical materials, devices, appliances, fittings, and other equipment installed intended for use in or attached to the mobile home shall be approved for the application and shall be connected in an approved manner when in service.

Wiring Methods and Materials

- Except as specifically limited in this part, the wiring methods and materials specified in the National Electrical Code shall be used in mobile homes.

Grounding

- Grounding of both electrical and nonelectrical metal parts in a mobile home shall be through connection to a grounding bus in the mobile home distribution panelboard.

Electrical Testing

- Each mobile home shall be subjected to:
  1) Dielectric strength test
  2) Continuity test
  3) Operational test
  4) Polarity checks

Wiring of Expandable Units (Double Wides)

- Expandable mobile homes shall use fixed-type wiring methods and materials for connecting such units to each other.

SUMMARY

For more detailed information on the National Construction Standards for mobile homes, the source of the preceeding outline would be consulted (Mobile Home Federal Construction and Safety Standards, H.U.D., Washington D.C., September 1975).

The new Federal Construction Standard is a very good effort to regulate mobile home construction. This standard will set guidelines for all jurisdiction and matters will be expedited from this reciprocity. A standard of this sort has been needed for a while and both the mobile home industry and consumer will benefit from it.

TRANSPORTATION CODE

Perhaps someday transport regulations will be established in the Federal Registrar like the new Construction Standards, but presently there are no nationwide standards enforced regarding the shipment of mobile homes. The absence of standardized travel times, signage, escort requirements, etc. results in poor efficiency. The following state transportation law chart (Table VII-4) helps to illustrate this major problem in the transport of mobile homes.

STATE TRANSPORTATION LAWS

FOR OVER-DIMENSIONAL HIGHWAY SHIPMENTS (MOBILE HOMES)

TABLE A-9

STATES	TOWING VEHICLE	TRAVEL LIMITATIONS	PERMIT FEES	SPEED LIMIT	ESCORT VEHICLE	INSURANCE (PERSONAL & ACCIDENT LIABILITY & PROPERTY DAMAGE)	SIGNAGE	PERMIT REQUIREMENTS	COMMENTS
MONTANA	12' WIDES-2 TON TRUCK W/DUAL AXEL DRIVE	NIGHT WEEK-END & HOLIDAY TRAVEL	(OVER 70'L) $6.00/TRIP	50 MPH MAX 20 MPH MIN	2 FLAG CARS WITH RADIO COMMUNICATION	$100,000 $300,000 $50,000	'WIDE LOAD' OR 'OVERSIZE' OR SIMILAR WORDING	UNITS OVER 14' WIDE NOT TO EXCEED 14' WIDE	OVERHEIGHT (+13' -6"). CAN BE OBTAINED - CONVOYS NO PER'
NEBRASKA	(12' WIDES) DUAL AXLE DRIVE CROSS WT. MAX. 6 TONS	NIGHT WEEK-END & HOLIDAY TRAVEL	(12' WIDES) CONTINUING PERMITS NOT ISSUED FOR INTERSTATE ROUTES	35 MPH MIN. OUTSIDE CITY LIMITS	2 FLAG CARS WITH COMMUNICATION	$25,000 $100,000 $10,000	(INTERSTATE HIGHWAY) "CAUTION WIDE LOAD" WARNING FLAG	UNITS OVER 8' WIDE AND OR 40' LONG	UNIT ON INTERSTATE HIGHWAY SHALL NOT EXCEED 12' WIDE
NORTH DAKOTA	(10' WIDES) 3/4TON TRUCKS (12' WIDE) 2 T. TRUCK W/ DUAL AXLE	NO NIGHT, WEEK-END & HOLIDAY TRAVEL	(10' WIDE) $5./TRIP (14' WIDE) $5/TRIP + ANNUAL PERMIT.	50 MPH MAX.	INTERSTATE HIGHWAY: (12' WIDE) 1 PILOT CAR (14'WIDE) 1 PILOT CAR	$100,000 $300,000 $ 50,000	"OVERSIZE LOAD" SIGN & WARNING FLAGS ON PILOT CARS & M.H.	UNITS OVER 8' WIDE AND OR 60' LONG	
SOUTH DAKOTA	(12' WIDES) 2 TON TRUCK	NO NIGHT, WEEK-END & HOLIDAY TRAVEL	$10/TRIP & 2¢/MI. FOR 14' WIDES	50 MPH MAX.	14'WIDE) 1 PILOT CAR	$100,000 $300,000 $ 20,000	"WIDE LOAD' SIGN ON ALL UNITS REQUIRING PERMITS		UNIT TRAILER HAS TO HAVE BRAKES & TAIL LIGHTS
WYOMING	NO RESTRICTIONS	(12' WIDES) NO NIGHT, INCLEMENT WEATHER & WIND TRAVEL	$5/TRIP SPECIAL PERMIT/ 19' LONG & 15'WIDES	POSTED LIMITS	(14'WIDE) 2 PILOT CARS ON 2 LANE RDS. & L ON INTERSTATES	NONE	"WIDELOAD OR SIMILAR WORDING	UNITS OVER 8'6" WIDE	

"If state's laws can be liberalized and made uniform at least some of the cost of over-the-road shipping can be squeezed out."[32] Other cost-saving ideas are: The use of electric light harnesses on units to cut down the use of escort vehicles. Piggy-back trucking of empty transport vehicles, and good routing to expedite movement.

WATER STANDARDS

State and local water standards in the Old West Region are well defined. The most rigid requirements are discussed in this section.

Domestic water standards require the following conditioning tolerances:

- Total dissolved solids (T.D.S.) shall not exceed 1000MG/Liter and not less than 500MG/Liter.
- Nitrates and nitrites shall not exceed 10MG/Liter and 45MG/Liter respectively.
- pH value shall be greater than 6 but not more than 9.
- Coliform shall not exceed a MPN or MF of 5000/100 millititers.
- Sulfates should not exceed 250MG/Liter.
- Fluorides should range between 1.0 to 1.2 MG/Liter.
- Iron should not exceed .3MG/Liter
- Manganese should not exceed .05MG/Liter

All treatment facilities shall have appropriate safety equipment. There shall be a licensed operator responsible for logging flows, keeping data on discharge, etc. The treatment facility must be fenced and have a lockable gate. There must be some provision made for power failure or equipment breakdown. The facility must have all weather access.

The following chart lists minimum distances between wells, suction lines, and reservoir and various sources of contamination.

CONTAMINATION SOURCE	DISTANCE TO WATER SUPPLY
Cast Iron/Plastic Sewer	20 Ft.
Clay or similar sewer	75 Ft.
Septic tank	150 Ft.
Disposal Field	150 Ft.
Seepage Pit	150 Ft.
Cesspool	150 Ft.

SOLID WASTE

As previously discussed all types of solid waste disposal will eventually lead to a dumping ground or landfill. All states require licensing of a major sanitary landfill. Processing of the license usually takes less than a month. In some instances depending upon locality and the particular situation no license is required. In either case a plan is required, showing layout and proximity of proposed and existing facilities. The landfill cannot endanger water sources, water storage, transmission lines, etc. The site geology, hydrology, climatology, and soil conditions will be reviewed by local authorities.

Landfill sites may be restricted to certain types or classifications of solid waste i.e. rubbish, vegetable waste, household garbage, etc. Other standard requirements include: Appropriate fencing, lockable gate, all weather access road, attendents or operators, appropriate equipment, etc.

Solid wastes must be covered with a minimum of 6 in. of approved fill at the end of each use day. Maximum total depth of the landfill will be 8 ft., including the final 2 ft. of compacted earth fill. Special considerations must be made for the handling of hazardous waste materials, although this may vary from locality to locality.

Incinerator sites must have all weather access roads, perimeter fencing with a gate, and an attendent while in operation. Temporary storage of wastes must be provided prior to incineration. Solid wastes to be burned must be controlled to keep the unloading area and charging floor clutter free, to reduce odors, and to eliminate insects and rodents.

The incinerator must use an auxiliary fuel. It must be smoke and odor free and conform to E.P.A. Air Pollution Standard 241.205. There must be an operator trained in the procedures of thermal processing. There must be appropriate safety and first aid equipment at the site.

Certain solid wastes will be excluded from incineration (see E.P.A. 240-201-1 of Federal Registrar, Vol. 39, No. 158). Excluded wastes must be posted at the facility gate. All water discharge from the site must meet applicable water quality standards.

Other restrictions are as follows: The site must meet aesthetic standards. There shall be records and monitoring data of the process. Residue and other solid waste products resulting from the thermal process must be disposed of in accordance with local sanitary Landfill Standards. For further information consult the Federal Registrar, Vol. 39, No. 158 "Thermal Processing and Land Disposal of Solid Waste - Guidelines".

SEWERAGE

Private sewerage systems are not allowed when a public system is available. All states have standards for infiltration and exfiltration of sewerage collection systems which include both pipe and manhole. In most cases certain pipe materials are recommended, although, these opinions are changing rapidly as new materials are proven as durable as the accepted ones.

There are other common standards which vary only slightly from locality to locality. These are:

- There shall be no discharge of sewage into unused wells or rock formations.
- Abandoned systems shall be disconnected and filled.
- No sewage shall be on the ground surface.
- Surface waters shall not enter the sanitary sewer system and vice-versa.
- Cesspools are prohibited.

Different types of treatment facilities will require specific regulations as to their design and layout. Appropriate safety equipment is required at every plant.

Effluent analysis must be logged and data on flows must be kept. A trained and a licensed operator is required to maintain a sewage treatment facility.

A potable discharge may be required depending upon locality and state regulations. The treatment facility must also have: a perimeter fence and lockable gate, a back-up power source, and an all weather access road.

AIR QUALITY

The following text discusses state Air Quality Standards, for incinerators, open burning, petroleum distillates, dust emissions and odors.

Any possible source of air pollution i.e. factory, mill, incinerators must submit an application to the State Board of Air Quality Standards before and during installation. Applications must include complete plans and specifications for the intended facility:

- Site plan (all effected area, river, prevailing wind, etc.)
- Plans and details of facility as a whole.
- Air quality control equipment plans.
- List of possible sources that may affect the performance of the air control unit.
- Operation procedures must be laid out in sequential form which will be the basis of application evaluation. Variances must be applied for before implementation.

After the facility is erected an initial set up and adjustment period is permitted before final testing begins. Tests will be made to insure the clean standards required of the equipment during operation.

Federal, State, and Local Standards on visibility, odor, and particulate matter are included in the appendix. The following is the most stringent combination of air quality standards.

INCINERATORS

No incinerator shall emit:

- .20 LB/100LB (2GMS/KG) of refuse at any one time.
- A discharge of no greater opacity than 20% unless the excess percentage results from water content.

The determination of the incinerator capacity shall be dependent upon the manufacturer's specifications and/or good engineering practices. No incinerator burning sewage sludge from a treatment facility shall emit:

- No more than .65 GMS/KG of dry sludge input (1.3 Lb/ton of dry sludge input.
- A discharge of no greater opacity than 20% unless the excess percentage results from water content.

Records and measurements must be kept on the volume of sludge charged to the incinerator. In some cases samples must be taken of the sludge. In all cases the facility must be approved by the Board of Air Quality Control for the sludge incineration and controls kept at 'State of the Art' Standards.

OPEN BURNING

There shall be no open burning except in rural areas where there are no organized disposal areas additional considerations include:

- o Population density must be less than 100 dwellings/Sq. Mi.
- o No trade wastes shall be disposed of via open burning.
- o Burning must occur on the property of the party who is responsible for the waste.
- o Burning must not obscure visibility around roadways, airports, etc.
- o States have particular regulations i.e. location of burning must be over 500 ft. from any neighboring residence, there shall be no burning of oil, rubber, etc.
- o Burning under conditions other than those listed above, require a permit and written approval from state and/or local authority.

PETROLEUM DISTILLATES AND RELATED EMISSIONS

Storage of gasoline and other petroleum distillates which have a reid vapor pressure (RVP) in excess of 5 lbs. in any stationary tank or reservoir, or other container of 40,000 Gal - 65,000 Gal (varies from state to state) shall be in a tank capable of maintaining a working pressure under any normal condition or confine all vapors.

A complete log of pressures (RVP) shall be kept on: Liquid stored, dates of readings, temperature, and in some cases the true vapor pressure will be required.

Automobile emissions shall conform to existing national standards. No existing pollution devices may be removed. These regulations do not apply to engines which have been altered to use fuels other than gasoline or diesel fuel.

FUGITIVE DUST EMISSIONS

There shall be no dust emission from any source which is designated as No. 1 on the ringleman chart, or 20% capacity, for more than three minutes in any consecutive 60 minutes. This does not include: unpaved rural roads with a daily average traffice count of less than 165 vehicles, agricultural cultivation, and dust caused by high winds.

Construction is also subject to the opacity regulation of 20%. If dust is a problem, water, oil, etc., must be used during construction to control fugitive dust.

ODORS

At a property line an odor emission shall not be detectable after seven dilutions with odor free air as measured by a scentometer (Barnebey - Cheney Company) the technique involved in this test varies from state to state. Odor causing materials must be contained in air tight materials and disposal must also meet the afore-mentioned regulations.

AIR STANDARDS

The following ambient Air Quality Standards are from "Wyoming Air Quality Standards and Regulations". Other state regulations in the Old West Region are similar because Federal Air Quality Standards is a common base.

PARTICULATES

The ambient air standards for total suspended particulates measured in accordance with recommended practices described in Designation D2009, lates revision, American Society for Testing and Materials are:

(1) 60 micrograms per cubic meter--annual geometric means;

(2) 150 micrograms per cubic meter--maximum 24 hour concentration not to be exceeded more than once per year.

The ambient air standard for suspended particulates soiling index, measured by a tope sampler, or by an equivalent method, expressed in Coh units related to optical density is:

(1) 0.4 Coh units per 1,000 lineal feet--annual geometric mean.

The ambient air standard for total settleable particulates, dustfall measured by a standard container of uniform cross-section, as described by Designation D1739, latest revision, American Society for Testing and Materials, or by an equivalent method are:

(1) 5 grams per square meter per month, for any 30 day period in residential areas. Includes 1.7 grams per square meter background;

(2) 10 grams per square meter per month, for any 30 day period in industrial areas. Includes 1.7 grams per square meter background.

SULFUR OXIDES

The ambient air standards for sulfur oxides measured by the pararosaniline (West-Gaeke) or equivalent methods are:

(1) 60 micrograms per cubic meter (0.02 ppm)--annual arithmetic mean;

(2) 260 micrograms per cubic meter (0.10 ppm)--maximum 24 hour concentration not to be exceeded more than once per year;

SULFURIC ACID MIST

Any existing facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, organic sulfides, mercaptans, or acid sludge shall limit the atmospheric discharge of acid mist in the effluent to not more than 0.50 pounds per ton of acid produced (0.25 kgm per metric ton),--maximum 2 hour average, expressed as H_2SO_4.

SULFATION

The ambient air standards for suspended sulfate measured as a sulfation rate by the lead peroxide method are:

(1) 0.25 milligrams SO_3 per 100 square centimeters per day, maximum annual average;

(2) 0.50 milligrams SO_3 per 100 square centimeters per day, maximum 30 day value.

HYDROGEN SULFIDE

The ambient air standards for hydrogen sulfide, measured by the mercuric chloride method, methylene blue method, or by an equivalent method are:

(1) 70 micrograms H_2S per cubic meter, 1/2 hour average not to be exceeded more than 2 times per year;

(2) 40 micrograms H_2S per cubic meter, 1/2 hour average not to be exceeded more than 2 times in any five consecutive days.

Any exit process gas stream containing hydrogen sulfide which is discharged to the atmosphere from any source shall be vented, incinerated, flared or otherwise disposed of in such a manner that ambient sulfur dioxide and hydrogen sulfide standards are not exceeded.

Fuel	Allowable SO_2 emission rate (1) (maximum 2 hr. average)
Coal	0.2 lb/10^6 BTU heat input
Oil	0.8 lb/10^6 BTU heat input

(1) Applicable to individual fuel burning equipment units with a heat input of 250 X 10^6 BRU/HR or greater.

Allowable SO_2 Emission Rate (2)
(Maximum 2 Hr. Average)

Fuel	Heat Input Between 250X10^6 BTI/Hr and 2500X10^6 BTU/Hr.	Heat Input Between 2500X10^6 BTU/Hr. and 5000X10^6 BRU/Hr.	Heat Input Greate Than 5000X10^6 BTU
Coal	1.2 LB/10^6 BTU Heat Input	0.5 LB/10^6 BTU Heat Input	0.3 LB/10^6 BTU Heat Input

(2) Applicable to individual fuel burning equipment units with the noted heat input values.

(3) 1,300 micrograms per cubic meter (0.50 ppm)--maximum 3 hour concentration not to be exceeded more than once per year.

Any existing facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, organic sulfides, mercaptans, or acid sludge shall limit the atmospheric discharge of sulfur dioxide in the effluent to not more than 2,000 ppm--maximum 2 hour average.

Any new facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, organic sulfides, mercaptans, or acid sludge shall limit the atmospheric discharge to sulfur dioxide in the effluent to not more than four pounds per ton of acid produced (2kgm per metric ton),--maximum 2 hour average.

The emission of sulfur dioxide (SO_2) from fuel burning equipment, the construction of which commences after January 1, 1974, shall be limited to the values shown in Table 1a.

The emission of sulfur dioxide (SO_2) from fuel burning equipment, the construction of which commenced prior to January 1, 1974, shall be limited to the values shown in Table 1b.

For purposes of Section 4d and 4e of these regulations, the heat input shall be the aggregate heat content of all fuels whose products of combustion pass through a stack or stacks or the heat input value used shall be the equipment manufacturer's or designer's guaranteed maximum input.

For purposes of Section 4d and 4e of these regulations, the SO_2 emission rate shall be determined by a source test method approved by the Division and shall be consistent with test method 6, Appendix A, Part 60 of Title 40 Code of Federal Regulations.

PHOTOCHEMICAL OXIDANTS

The ambient air standard for photochemical oxidants, measured and corrected for interferences from nitrogen oxides and sulfur dioxide by the reference method described in Appendix D, Federal Register, Volume 36, No. 84, April 3, 1971, or by an equivalent method is:

(1) 160 micrograms per cubic meter (0.08 ppm)--maximum 1 hour concentration not to be exceeded more than once per year.

HYDROCARBONS

The ambient air standard for hydrocarbons, measured and corrected for methane by the reference method described in Appendix E, Federal register Volume 36, No. 84, April 30, 1971, or by an equivalent method is:

(1) 160 micrograms per cubic meter (0.24 ppm)-- maximum 3 hour concentration (6:00 a.m. to 9:00 a.m.) not to be exceeded more than once per year.

Hydrocarbon emissions shall be limited by all persons handling, transporting, or storing volatile organic compounds to prevent unnecessary emissions to the extent that ambient air standards described in these standards are exceeded. Measures considered appropriate for such control, or any equivalent method shall be:

(1) All waste disposal combustion systems for organic compounds from a vapor blowdown or emergency relief system shall be burned by smokeless flares or an equally effective control device;

(2) The storage of gasoline or petroleum distilleries having a Reid Vapor Pressure (RVP) in excess of five pounds in any stationary tank, reservoir, or other container of more than 65,000 gallons shall be in a pressure tank capable of maintaining working pressures sufficient at all times to prevent vapor or gas loss to the atmosphere;

(3) Floating roofs, consisting of a pontoon type, double deck type roof, or internal floating cover, resting on the liquid surface, equipped with seals between the roof and tank wall shall be considered as appropriate control equipment to prevent such vapor loss. Tank gauging devices shall be gas tight except when tank gauging or sampling is taking place;

(4) Vapor recovery system capable of collecting volatile organic vapors and a disposal system capable of processing such vapors in a manner that prevents their discharge to the atmosphere shall be considered as appropriate control equipment to prevent such vapor loss.

NITROGEN OXIDES

The ambient air standard for nitrogen dioxide, measured by the reference method described in Appendix F, Federal Register, Volume 36, No. 84, April 30, 1971, or by an equivalent method is:

(1) 100 micrograms per cubic meter (0.05 ppm)--annual arithmetic mean.

The emission standards for nitrogen oxides, measured by the method described in Appendix, Method 7, Federal Register, Volume 36, No. 159, August 17, 1971, or by an equivalent method are:

(1) The emission of nitrogen oxides from new gas fired fuel burning equipment calculated as nitrogen dioxide shall be limited to 0.20 pound per million BTU (0.36 grams per million gram calories) of heat output.

(2) The emission of nitrogen oxides from existing gas fired fuel burning equipment calculated as nitrogen dioxide shall be limited to 0.23 pound per million BTU (0.41 grams per million gram calories) of heat input.

(3) The emission of nitrogen oxides from new oil fired fuel burning equipment calculated as nitrogen dioxide shall be limited to 0.30 pounds per million BTU (0.54 grams per million gram callories) of heat input for units having a heat input of 1.0 million BTU per hour (250 million gram calories/hour) or greater and 0.60 pounds per million BTU (1.08 grams per million gram calories) of heat input for units having a heat input less than 1.0 million BTU per hour (250 million gram calories/hour).

(4) The emission of nitrogen oxides from existing oil fired fuel burning equipment calculated as nitrogen dioxide shall be limited to 0.46 pound per million BTU (0.83 grams per million gram calories) of heat input for units having a heat input of 250 million BTU per hour (62.5 gram calories/hour) or greater and 0.60 pound per million BTU (1.08 grams per million gram calories) of heat input for units having a heat input less than 250 million BTU per hour (62.5 billion gram calories/hour).

(5) The emission of nitrogen oxides from new nitric acid manufacturing plants, calculated as nitrogen dioxide shall be limited to 3 pounds per ton (1.5 kilograms per metric ton) of acid produced, maximum 2 hour average.

(6) The emission of nitrogen oxides from existing nitric acid manufacturing plants, calculated as nitrogen dioxide shall be limited to 5.5 pounds per ton (2.8 kilograms per metric ton) of acid produced, maximum 2 hour average.

(7) The emission of nitrogen oxides from new solid fossil fuel (except lignite) fired equipment calculated as nitrogen dioxide shall be limited to 0.70 pounds per million BTU (1.26 grams per million gram calories) heat input.

(8) The emission of nitrogen oxides from existing solid fossil fuel (except lignite) fired equipment calculated as nitrogen dioxide shall be limited to 0.75 pounds per million BTU (1.35 grams per million gram calories heat input.

The requirements of this section shall not apply to internal combustion engines having a heat input of less than 200 million BTU per hour.

FLUORIDES

The ambient air standard for fluorides measured as hydrogen fluoride is:

(1) 0.80 micrograms per cubic meter (1 part per billion 24 hour average or when the concentration of fluorides in forage for animal consumption, measured as fluorine, dry weight basis is 25 micrograms per gram.

The ambient air standard for gaseous fluorides measured by the sodium formate paper method or equivalent is 0.3 micrograms per square centimeter, maximum 30 day value.

CARBON MONOXIDE

The ambient air standard for carbon monoxide, measured by nondispersive infrared spectrometry, as described in Appendix C, Federal Register, Volume 36, No. 84, April 30, 1971, or by an equivalent method is:

(1) 10 milligrams per cubic meter (9 ppm)--maximum 8 hour concentration not to be exceeded more than once per year;

(2) 40 milligrams per cubic meter (35 ppm)--maximum 1 hour concentration not to be exceeded more than once per year.

The emission of carbon monoxide in stack gases from any stationary source shall be limited as may be necessary to prevent ambient standards described in this standard from being exceeded. Measures considered appropriate for such control are:

(1) Treatment of the waste gas stream by installation and use of a direct flame afterburner or other means which will achieve the required reduction as approved by the Division.

RESPONDENTS OF MANUFACTURER'S QUESTIONAIRE

Mobile Homes

Bonna Villa
Mobile Home Division of Chief Ind.
Aurora, Nebraska

Central Homes, Inc.
237 22nd Street
Greeley, Colorado 80631

Century Housing Corporation
P. O. Box 737
Fort Morgan, Colorado 80701

Champion Home Builders Company
5573 North Street
Dyrden, Michigan 48428

Chickasha Mobile Homes, Inc.
Highway 81 North
P. O. Box 405
Chickasha, Oklahoma 73018

Continental Mgf. Company
P. O. Box 269
999 Van Buren Avenue
Loveland, Colorado 80537

Detroiter Mobile Homes, Inc.
1517 Virginia Street
St. Louis, Michigan 48880

DG Leisure Products Utah Division
P. O. Box 725
Ephraim, Utah 84627

Elder-Quinn, McGill, Inc.
4800 Race Road
P. O. Box 16159
Denver, Colorado 80216

Ft. Lupton Modular Builders
P. O. Box 223
Fort Lupton, Colorado 80621

Interstate Homes, Inc.
1840 South 700 West
Salt Lake City, Utah 84104

Mobile Office Mfg. & Leasing Corporation
5700 South Riverside Drive
Murray, Utah 84107

Moduline International Inc.
P. O. Box 209
Chehalis, Washington 98532

Rex Mobile Homes
P. O. Box 178
McMinnville, Oregon 97128

Rushmore Homes
P. O. Box 509
Rapid City, South Dakota 57701

Schult Mobile Home Corporation
P. O. Box 151
Middlebury, Indiana 46540

Skyline Mobile Homes
P. O. Box 5446
1445 Commerce Avenue
Boise, Idaho 83705

Style Homes
Riverton, Wyoming 82501

Tamarack Homes
Division Champion Home Builders Co.
P. O. Box 190
Weiser, Idaho 83672

Pre-Engineered/Metal Buildings

A & S Steel Buildings
P. O. Box 40099
Houston, Texas 77040

Lear Siegler, Inc.
Cuckier Division
P. O. Box 346
Montilello, Iowa 52310

Mitchell Engineering Company
P. O. Drawer 911
Columbus, Mississippi 39701

Pascoe Steel
1301 East Lexington Avenue
P. O. Box 2628
Pomona, California 91766

Structures Unlimited
P. O. Box 105
Manchester, N. H. 03105

Domes & Air Structures

Birdair Structures, Inc.
2015 Walden Avenue
Buffalo, New York 14225

Geodesic Domes, Inc.
10290 Davison Road
Davison, Michigan 48423

Dome East Cord
325 Duffy Ave.
Hicksville, New York 11801

Irvin Industries, Inc.
555 South Broadway
P. O. Box 989
Lexington, Kentucky 40501

Temcore Geodesic Dome
2825 Toledo Street
Torrance, California 90503

HOWARD NEEDLES TAMMEN & BERGENDOFF

October 9, 1975

Manufacturer's Address

Dear Sir:

We are compiling a survey for the Old West Regional Commission regarding Mobile/Temporary Facilities for impacted areas. Often areas suffer from the influx of 500 to 2,000 construction workers and their families. This sudden influx disrupts the existing balance of community facilities. Our search is to find Temporary/Mobile structures being currently manufactured to house a variety of activities. The activities include a whole range of public and private services from housing, police protection, recreation, to waste treatment. If you could answer the enclosed questionaire, it would make our recommendations much easier.

Please check or circle any relevant descriptions on the questionaire. Any further data would be appreciated. If you have any questions, please contact me.

Thank you for your assistance.

Sincerely,

HOWARD, NEEDLES, TAMMEN & BERGENDOFF

M. Richard

Mark Richard

MR:mg

Enclosure

Architects Engineers Planners
P.O. Box 3101, Intermountain Building, Casper, Wyoming 62601, 307 266-7199

Partners H C Lamberton, Jr PE, James F Finn PE, Paul L Heineman PE, Joseph H Looper PE, Robert O Drange PE Bernard H Rottinghaus PE, Gerard F Fox PE, William M Wachter PE, George K Erganian PE, Browning Crow PE, Charles T Hennigan PE, Edgar B Johnson PE, Daniel J Watkins PE, Ralph E Myers FAIA Daniel J Spigai PE
Associates Daniel J Appel PE, William C Meredith PE, Orrin Riley PE Francis X Hall PE, Robert W Richards PE, Robert S Coma PE, Don R Ort PE, John L Cotton PE, Donald A Dupies PE Frederick H Sterbenz PE
Offices Alexandria VA, Atlanta, Baltimore, Baton Rouge, Boston Buffalo, Cape Coral FL, Casper, WY Charleston, WV, Chicago, Cleveland, Dallas, Denver Fairfield NJ Indianapolis Kansas City Miami, Milwaukee, Minneapolis Newark DE New York Orlando Overland Park KS Philadelphia Richmond, Seattle Washington DC, Woodbridge NJ Beirut Lisbon, Rio de Janeiro

INDUSTRY CHARACTERISTICS

1. Ownership
    - a. Public Owned
    - b. Privately Owned
    - c. Franchised

2. Primary Activity
    - a. Housing
    - b. Multi-Use
    - c. Pre-Engineered
    - d. Portable
    - e. Commercial
    - f. Other (please specify)

3. Services
    - a. Arch/Eng.
    - b. Production
    - c. Erection
    - d. Management

4. Market Areas
    - a. Regional U. S. (please describe)
    - b. All U. S.
    - c. Europe
    - d. Canada
    - e. Other (please specify)

5. Management System
    - a. Open
    - b. Closed
    - c. Consortium

6. Acquisition Methods
    - a. Outright Purchase
    - b. Rent
    - c. Lease Purchase

7. Bidding Options
    - a. Performance Bidding
    - b. Traditional Bidding
    - c. Turnkey

PRODUCT DESCRIPTION

1. Primary Product
    - a. Housing
    - b. Multi-Use

c. Pre-Engineered
d. Air Structure
e. Portable
f. Dome
g. Other

2. Structural System

   a. Frame
   b. Panel
   c. Module-Box
   d. Space Frame/Truss
   e. Other (please specify)

3. Material

   a. Wood
   b. Concrete
   c. Steel
   d. Other (please specify)

4. Span Limits (please specify maximum spans or maximum unit dimensions)

5. Story Height

   a. Floor/Ceiling
   b. Floor/Floor
   c. Varies

6. Stackability (number of stones)

7. Flexibility

   a. Fixed
   b. Semi-fixed
   c. Removable

SUB-SYSTEMS

1. Foundations

   a. Slab
   b. Perimeter
   c. Piles
   d. Grade Beam
   e. None

2. Floor System

   a. Concrete
   b. Concrete on Metal
   c. Wood
   d. None

3. Finish Floor

   a. Unlimited
   b. Limited

4. Ceiling System
    a. Plaster on Wood
    b. Plaster on Metal
    c. Suspended Ceiling
    d. Integrated w/ Lights
    e. Exposed Decking
    f. None

5. Ceiling Material
    a. Unlimited
    b. Limited

6. Roof System
    a. Built-Up
    b. Metal
    c. Other
    d. Sloped (degree of slope)
    e. Flat
    f. None

7. Envelope System
    a. Pre-Cast
    b. Masonry
    c. Wood
    d. Metal
    e. Plastic
    f. None

8. Partition System
    a. Fixed
    b. Flexible
    c. On a Grid
    d. None

9. Partition Material
    a. Plaster on Wood
    b. Plaster on Metal
    c. Metal
    d. Sandwich Panel
    e. Masonry
    f. Concrete

10. Electrical System
    a. Included
    b. Not Included

11. HVA-C System
    a. Ceiling Duct
    b. Floor Duct
    c. Composit Unit

   - d. Wall Unit
   - e. Other
   - f. None

12. Furnace Size (Great Plains Area)

13. Insulation (Thermal Coefficients - V)

    - a. Exterior Walls
    - b. Roof

PRODUCTION-TRANSPORTATION

1. Fabrication

   - a. Off-Site
   - b. On-Site
   - c. Combination
   - d. By Local Resources

2. Fabrication Quantity (area/time or units/time)

3. Transportation

   - a. By Company
   - b. Sub-Contracted
   - c. Road
   - d. Railroad
   - e. Other

4. Range

   - a. Limit (distance of maximum range)
   - b. Cost (per mile/per unit)

5. Erection

   - a. By Product Manufacturer
   - b. Sub-Contracted
   - c. Technical Assistance
   - d. Franchise Dealer

6. Erection Quantity (area/time or unit/time)

7. Disassembly for Relocation

   - a. Simple
   - b. Complex
   - c. Not Necessary
   - d. Not Feasible

8. Building Cost (cost/area)

   - a. Installation Labor ______________
   - b. Manufactured Components (Structural)

    c. Mechanical Equipment
    d. Electrical Equipment

RELOCATABLE FACILITIES EXPERIENCE

1. Space Types (types you have installed & removed & relocated)
    a. Housing
    b. Commercial
    c. Recreation
    d. Manufacturing
    e. Medical
    f. Other
2. Location
    a. Regional U. S. (please specify region)
    b. Nationwide
    c. International (please specify countries)
3. How Feasible are your Manufactured Units for Relocatable Facilities
    a. Transport

    b. Disassembly

    c. Adaptability

CONTRACT DATA

1. Contractural Preference
    a. Multiple Contract
    b. Single Contract
    c. Turnkey
    d. Negotiated
    e. Performance Type
    f. Other
2. Delivery Time After Contract

WATER TREATMENT & PIPING MANUFACTURERS

MANUFACTURER/REPRESENTATIVE	PRODUCT
Aerated Lagoons Contact: Carl F. Hodgkinson 4000 Forest Street Denver, Colorado 80210	Sewage treatment facility
Air-O-Gest Sewage System Contact: Case Cotter, Inc. 6625 East 49th Drive Commerce City, Colorado 80022	Sewage treatment facility (Extended aeration)
Capitol Controls Company Advance Lane Colmar, Pennsylvania 18915	Water & sewage treatment, chlorinators, flow meters, etc.
Cemco Products, Inc. Building 228 Snohomish County Everett, Washington 98201	Pre-insulated pipe
Envirotech Corporation Municipal Equipment Division 315 East 2nd South 306 ElPaso Building Salt Lake City, Utah 84111	Water treatment, filters, flocculators, clarifiers, etc.
General Filter Company Contact: Ted D. Miller Assoc. 2140 South Ivanhoe Street Denver, Colorado 80222	Manufacturers Engr. Rep. for filters, autotrols, biosurf, (water treatment plants)
Fisher & Porter Company County Line Road Warminster, Pennsylvania 18974	Water & sewage treatment, chlorinators, metering, etc.
Infilco, Fuller Company P. O. Box 5033 Tucson, Arizona 84703	Water & sewage treatment, chlorinators, tankage, filters, softeners, etc.
Insul-8 Rovanco Corporation 210 So. Center Street Joliet, Illinois 60436	Pre-insulated pipe
Johns-Manville Contact: Jim Andrews 70 West 6th Avenue Denver, Coloraro 80204	Pre-insulated pipe

Laval Separator Corporation 1899 North Helm P. O. Box 6119 Fresno, California 93727 OR 8254 West 71st Avenue Denver, Colorado 80200	Solids handling and liquid separation
International Marketing & Research, Inc. Mr. William J. Heinrich 8580 West Colfax Avenue Denver, Colorado 80215	Water & sewage treatment facilities (physical/chemical)
Lyco-ZF, Waste Water Equipment Penberthy, Houdaille Water & Waste Water Systems P. O. Box 112 Prophetstown, Illinois 61277 Contact: Jack B. Byerrum 700 Sheridan Boulevard Denver, Colorado 80214	For treatment facilities both individual and additions to existing systems
Met-Pro Systems Division Contact: Wright Associates 8000 West 14th Avenue Lakewood, Colorado 80215	Water & sewage treatment facilities (physical/chemical type unit)
Neptune Microfloc, Inc. Contact: Jack Sampson Water Control Corporation 2124 South Birch Denver, Colorado 80200	Water treatment (activated bio-filtration system)
Pennwalt, Wallace & Tiernan Excelsior Boulevard 3983 Zarthan Avenue South Minneapolis, Minnesota 55416	Chlorinators & other control equipment for water and sewage treatment
Precipitator, Inc. 12040 Florence Avenue Santa Fe Springs, California 90670 Mr. John Levingston	Water & sewage treatment facilities, resource recovery (physical/chemical type unit)
Sanilogical Corporation 88 Steele Street Denver, Colorado 80206	Sewage treatment systems (extended aeration)
Vertecs Seattle, Washington (206)-743-6511	Pre-insulated pipe

Structure Types	Description	Total Area	Permanent Foundation Unit Price	Permanent Foundation Total Price	Erection Labor Unit Price	Erection Labor Total Price	Bldg. Materials Unit Price	Bldg. Materials Total
HOUSING								
Mobile Homes	Avg. M.H. Area						$16/S.F.	$6,400,000
500 Units	800 S. F.	400,000 S.F.			$100/M.H.	$40,000		
	Foundation & Tie Downs						200/M.H.	100,000
COMMERCIAL								
Mall	Air Structure	50,000 S.F.	$10/S.Y.	$56,000	1.00/S.F.	50,000	10/S.F.	500,000
Restaurant/Lounge	3 Modulars	5,500 S.F.			200/Bldg.	600	26/S.F.	143,000
Building Materials	Metal Bldg.	4,000 S.F.	9/S.Y.	3,600	1.00/S.F.	4,000	15/S.F.	60,000
Bank	Mobile Home	500 S.F.			100/M.H.	100	25/S.F.	12,500
Barber/Beauty Salon	Mobile Home	800 S.F.			100/M.H.	100	25/S.F.	20,000
Gas Station	M.H. Sales Area	600 S.F.			100/Unit	100	20/S.F.	12,000
	Metal Garage	900 S.F.	9/S.Y.	900	100/S.F.	900	15/S.F.	13,500
	Concrete Service			5,000				
	Tankage & Pumps					2,000		15,000
Laundry	Mobile Home	300 S.F.			100/Unit	100	25/S.F.	7,500
Motel/Apartments	Mobile Home	16,500 S.F.			200/Unit	4,000	20/S.F.	330,000
EDUCATION								
Day Care	Mobile Home	840 S.F.			100/Unit	100	20/S.F.	16,800
Elementary	Short Span (M.H.)	8,065 S.F.			200/Unit	2,000	19/S.F.	153,235
	Long Span (Metal)	1,520 S.F.	9.00/S.Y.	1,520	1.00/S.F.	1,520	16/S.F.	24,320

COST ANALYSIS architecture

TABLE A-10

Structure Types	Description	Total Area	Permanent Foundation Unit Price/Total Price		Erection Labor Unit Price/Total Price		Bldg. Materials Unit Price/Total	
EDUCATION-continued								
Secondary	Short Span (M.H.)	6,515 S.F.			$200/Unit	$1,600	$19/S.F.	$123,7
	Long Span (Air)	7,000 S.F.	$9.00/S.Y.	$7,000	15/S.F.	1,050	6/S.F.	42,0
Maintenance	Metal Bldg.	1,000 S.F	9.00/S.Y.	1,000	1.00/S.F.	1,000	15/S.F.	15,0
COMMUNITY								
Fire Station	Metal Bldg.	800 S.F.	9.00/S.Y.	800	1.00/S.F.	800	15/S.F.	12,0
Administration/Police	Mobile	1,400 S.F.			100/Unit	200	22/S.F.	30,8
Post Office	Mobile	1,200 S.F.			100/Unit	200	22/S.F.	26,4
Maintenance/Treatment	Metal Bldg.	3,000 S.F.	9.00/S.Y.	1,000	1.00/S.F.	3,000	15/S.F.	45,0
Medical Clinic	Mobile Bldg.	800 S.F.			100/Unit	100	20/S.F.	16,0
	Equipment							44,0
ARCHITECTURAL SUBTOTAL								
				$76,820		$123,470		$8,162

Equipment Type	Description	Quantity	Installation Unit Price	Installation Total Price	Material Unit Price	Material Total Price
TREATMENT						
Water Treatment		1	$ 1,000/Unit	$ 1,000	$100,000/Unit	$100,000
Sewage Treatment		1	1,000/Unit	1,000	100,000/Unit	100,000
WATER DISTRIBUTION						
Pipe	6" PVC Pressure Pipe	30,240′	5.77/Ft.	174,484	4.23/Ft.	127,915
	8" PVC Pressure Pipe	5, 280′	5.92/Ft.	31,258	6.08/Ft.	32,102
Hydrants:						
	Dual Outlet Dry Barrel	50			344.94/Each	17,247
	6" Companion Valves	50			15.37/Each	769
	6" Tees				12.66/Each	633
Pumps:						
	Sump Pump w/tank	84			2,000/Each	168,000
	Switches & Valves					
Fittings:	Reduction Tees (6" to 4")	18			12.28/Each	221
	4" 90^{0} Elbows	9			2.28/Each	26
	4" Tees	84			3.77/Each	317
Valves:	4" Check Valves	27			205.49	5,500
ELECTRICAL DISTRIBUTION						
Main Distribution line	350 MCM 3 Strand Non insulated	32320'(3)	.50(3)/Ft	48,480	(3) .42/Ft	40,723
Power Poles	20 Ft. Poles	108	187.50/Each	20,250	150/Each	16,200
Transformers						
Residential	75 KVA	85	590/Each	50,830	1,959/Each	166,515
Community	225 KVA	5	1,356/Each	6,780	3,602/Each	18,010

COST ANALYSIS

engineering

Equipment Type	Discribtion	Quantity	Installation Unit Price	Installation Total Price	Materials Unit Price	Materials Total Price
ELECTRICAL DISTRIBUTION - continued						
Junction Box	PVC.	90	$250/Each	$22,500	$ 88/Each	$ 7,920
Meters	Grouped Meters w/circuit breakers	85	150/Each	13,500	380/Each	34,200
Service Lines:						
Wiring	Residential 3 strands of 50 AMP #6 Wire	68,000 Ft.	.17/Ft	11,560	.10/Ft.	6,800
	Community 4 strands of 100 AMP Wire	1,000 Ft.	.27/Ft	270	.28/Ft.	280
Conduit	Residential 1" PVC Pipe	68,000 Ft	.65/Ft.	44,200	.42/Ft	28,560
	Community 1-1/2" PVC Pipe	1,000 Ft.	.85/Ft.	850	.68/Ft.	680
ENGINEERING SUBTOTAL						
				$782,889		$1,021,280

Installation Types	Description	Labor & Materials Unit Price	- Total Price
RECREATION			
Hard Surface Area	Combination of 2 tennis courts, basketball & volly-ball equipment	$15,000/Court	$ 30,000
Tot Lots	8 Lots @ 4,000 S.F. Each	4,000/Lot	32,000
Picnic Shelter	1	4,000/Shelter	4,000
Horseshoe Court	1	1,000/Court	1,000
LANDSCAPING			
Excavation:			
	Residential Lots 50 C.Y/Lot x 500 Lots 25,000 C.Y. @	1.00/C.Y.	25,000
	Recreation Areas & Greenways 20,000 C.Y. @	1.00/C.Y.	20,000
Planting			50,000
EDUCATION			
Hard Surface Area	Elementary 21,000 S.F.	1.00/S.F.	210,000
	Secondary 10,000 S.F.	1.00/S.F.	100,000
PARKING			
Residential	2 spaces/lot @450 S.F. each set (500 Lots) 224,000 S.F.	2.80/C.Y.	105,000
Commercial	Motel one space/room + service area 90 spaces @ 300S.F.	27,000 S.F.	12,600
	Food & Drink one space/45 S.F. interior 9,500 S.F.= 210 Spaces or 63,000 S.F.		29,400
	Retail Stores 2 S.F. parking/1S.F. sales area 2 x 40,000 = 8,000 S.F.		37,333

COST ANALYSIS town planning

Installation Types	Description	Labor & Materials	
		Unit Price -	Total Price
PARKING - continued			
Community	Medical Clinic one space/100 S.F. interior 300 S.F./100 S.F. = 8 spaces or 2,400 S.F.		$ 1,120
	Schools - High School one space/3 seats = 30 spaces or 9,000 S.F.		4,200
	Other one space/teacher + visitor parking 20 spaces or 6,000 S.F.		2,800
	Government - Police/Fire/Administration/Post Office 22 spaces or 6,600 S.F.		3,080
PARKING SUBTOTAL			
	480,500 S.F. of 6" LOCAL FILL AND COMPACTED @ $2.80/CY		24,920
ROADS			
Excavation	25,000 C.Y.	1.00/C.Y.	25,000
Paving	Asphalt - 5,280 Ft.	150,000/Mile	150,000
	Agregate/Oiled 20,400 Ft.	80,000/Mile	309,000
TOWN PLANNING SUBTOTAL			
			1,271,533

COST ANALYSIS community total

	UNRECLAIMABLE COSTS (LABOR & PERMANENT INSTALLATIONS)	REUSEABLE MATERIALS AND STRUCTURE COSTS
ARCHITECTURE SUBTOTAL	$ 76,820	$ 8,162,840
	123,470	
ENGINEERING SUBTOTAL	782,089	1,021,280
TOWN PLANNING SUBTOTAL	1,271,533	
COMMUNITY TOTAL	2,254,712	9,194,120

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